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# Diagnostic accuracy of TI-RADS classification in differentiating benign and malignant thyroid nodules-a study from Southern Punjab, Pakistan

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## ABSTRACT

**Background and Objective:** Thyroid imaging reporting and data system (TI-RADS) is developed to determine the risk of malignancy in patients with thyroid nodules. The aim of this study was to determine the diagnostic accuracy of TI-RADS classification for diagnosing malignant thyroid nodules taking Fine needle aspiration cytology (FNAC) as a gold standard in the local population.

**Methods:** In this cross-sectional validation study, 201 patients presenting with thyroid nodules at the Department of Radiology, Bakhtawar Amin Hospital Multan, Pakistan from July 2020 to December 2020 were included. In all patients, thyroid nodules were evaluated on grey scale (B-mode) modality. TI-RADS score was calculated for each patient. Patients with TI-RADS score 4 and 5 were labelled as having malignant nodules. After that FNAC samples were taken and sent for histopathologic evaluation of thyroid nodules. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of TI-RADS taking FNAC as a gold standard were determined.

**Results:** The mean age of the patients was  $47.8 \pm 4.5$  years; there were 129 (67.2%) women and 72 (35.82%) men. There were 42 patients who tested true positive and 36 patients tested false positive and 12 patients were false negative and 111 patients true negative. The TI-RADS sensitivity was 77.8%, specificity was 75.5%, PPV was 53.8%, and NPV 90.2%. the diagnostic accuracy was 76.1%.

**Conclusion:** Differentiating benign thyroid nodules from malignant using the TI-RADS score has a high diagnostic accuracy. Our study results support the TIRADS as a first-line imaging evaluation for diagnosis of thyroid malignancy.

**Keywords:** Thyroid nodules, ultrasonography, fine needle aspiration cytology, TI-RADS.

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## Introduction

Thyroid diseases account for one of the commonest health problems in South Asia, especially in Pakistan due to iodine deficiency in the diet; the prevalence of men being higher than the women.<sup>1</sup> Thyroid nodules can be identified using high-frequency ultrasound (US) with a high prevalence rate of 19% to 67% in different populations.<sup>2</sup> Based on research reports, up-to 90% of nodules are benign and up-to 10% of these are malignant.<sup>3</sup> The early detection and diagnosis between benign and malignant thyroid nodules can be lifesaving. Fine-needle aspiration cytology (FNAC) further augments the conclusive diagnosis. The ultrasonography (USG) is a non-invasive, cost-effective, and safe method. Once any suspicious nodule is reported by the clinician, the

US-guided FNAC is planned as the clinical management is based on accurate diagnosis.<sup>4</sup> FNA is a simple and minimally invasive way of diagnosing thyroid nodules.<sup>5</sup> The size, shape, micro-calcifications, and echogenicity are the key features to identify evidence of malignancy in the thyroid nodules.<sup>6</sup>

Worldwide, many classification systems are available based on the risk of thyroid malignancy. Thyroid imaging reporting and data system (TI-RADS) has a high sensitivity for assessment of thyroid malignancy.<sup>7</sup>

The present study aims to determine the diagnostic accuracy of TI-RADS classification for diagnosing malignant thyroid nodules taking FNAC as a gold standard in a local population of Southern Punjab.

### Methods

In this cross-sectional validation study, 201 patients who were referred for ultrasonic evaluation of thyroid nodules to the Department of Radiology, Bakhtawar Amin Hospital Multan, Pakistan within duration of 06 months (July 2020 to December 2020) were included. Patients with already diagnosed carcinoma of thyroid and/or patients with exclusively cystic nodules were excluded. Informed consent was taken from all the patients and Ethical approval was obtained from Institutional Ethical Committee.

In all patients, USG was done using VERSANA Essential (GE Healthcare) machine. Thyroid nodules were evaluated on grey scale (B-mode) modality using high frequency (12 MHz) probe. All USG were done and analyzed by consultant radiologists and TI-RADS score was calculated. Fine-needle aspiration cytology was done and sent to the histopathology department for the diagnosis of malignancy. TI-RADS score was calculated and divided into four categories as given below in the concert flow diagram (Figure 1). Statistical analysis was done based on the cytology results.

### Statistical analysis

Data were analyzed using SPSS v 20. Mean and the standard deviation were used for quantitative variable such as age. Qualitative variables like gender, presence/absence of malignant lesions using TI-RADS and FNAC. 2 × 2 contingency table was used to calculate sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of TI-RADS taking FNAC as a gold standard.

### Results

In this study, the age range of 201 patients of both genders, presenting with thyroid nodules, was between 18 and 65 years. The mean age was 47.8 ± 4.5 years; there were 129 (67.2%) females and 72 (35.82%) males. Mean tumors size was 22.5 ± 5.6 mm. Based on TI-RADS score 4 to 5, thyroid malignancy was suspected in 64 (31.84%) patients, while 137 (68.15%) patients were having a score less than 3, hence having the probability of benign lesions (Figure 2). FNAC confirmed malignancy (Figure 3) in 55 (27.36%) patients (Table 1). The TI-RADS sensitivity, specificity, PPV and NPV

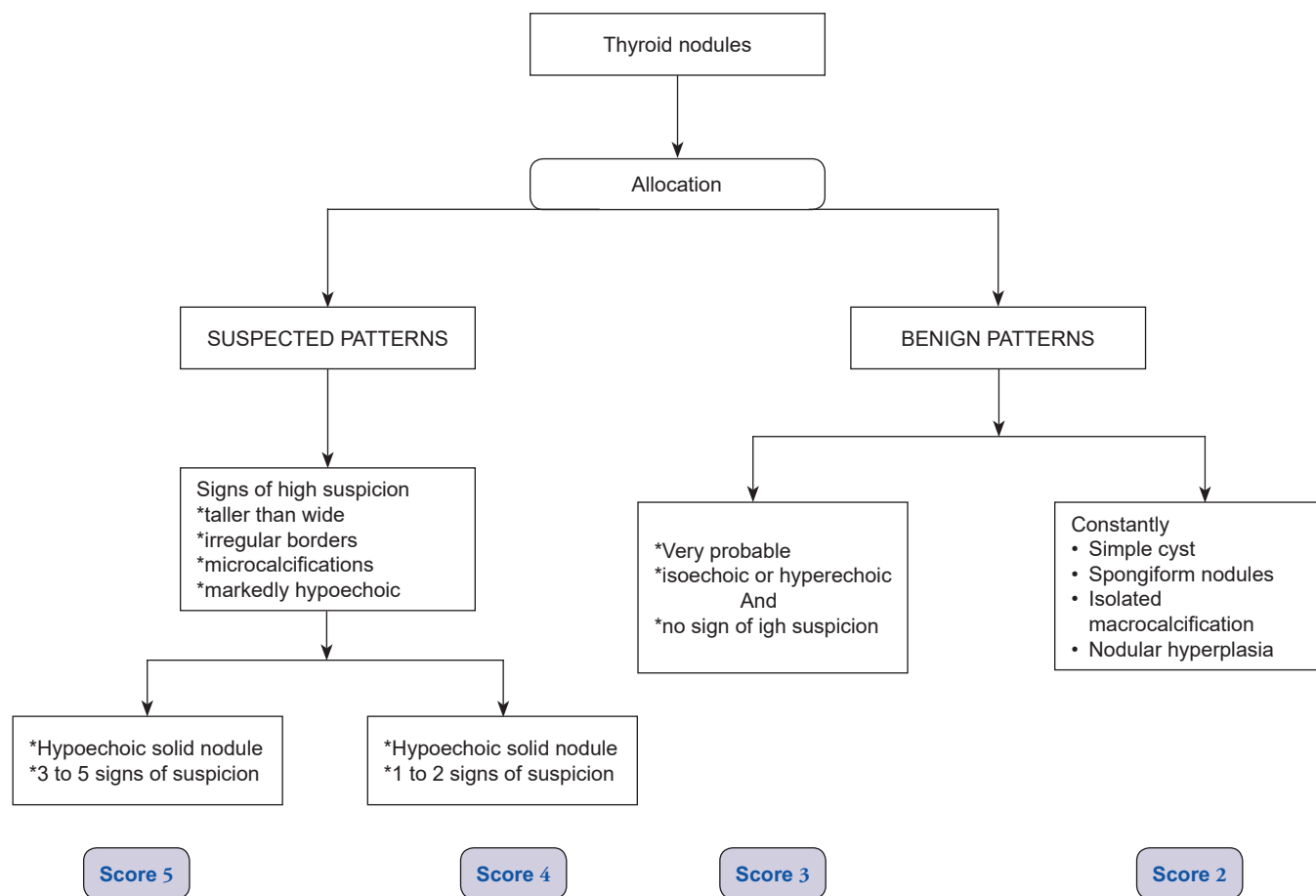


Figure 1. TI-RADS classification of thyroid nodules.

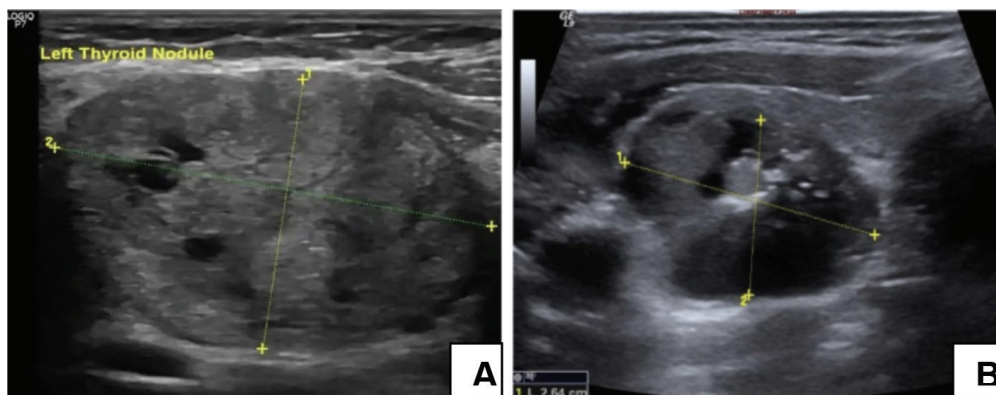


Figure 2. US showing benign (A) and malignant (B) thyroid nodules.

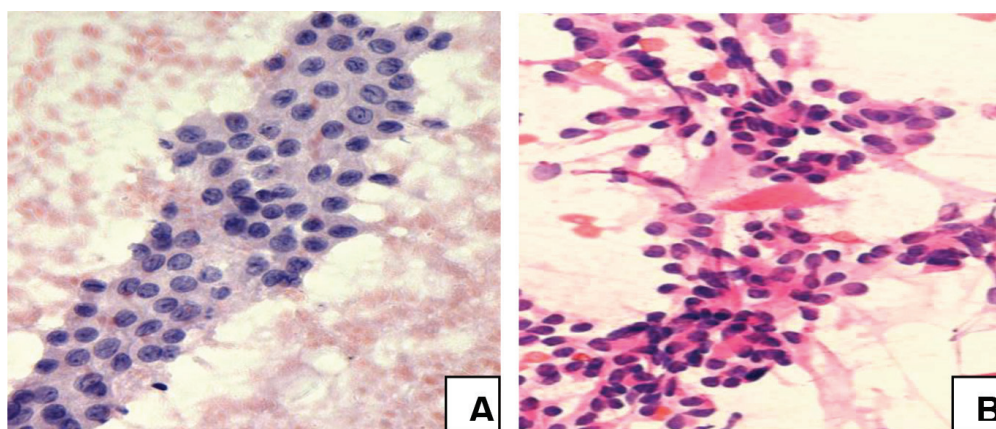


Figure 3. FNAC showing benign (A) and malignant (B) thyroid nodules.

Table 1. Baseline study and diagnostic variables.

Clinical and diagnostic characteristics	N(%)
Age (years)	47.8 ± 4.5
Gender	
Male	72 (35.82%)
Female	129 (67.2%)
Size of tumor (mm)	22.5 ± 5.6
Diagnosis of malignant lesions.	
TI-RADS scoring	
1-3	137 (68.15%)
4-5	64 (31.84%)
FNAC	
Yes	55 (27.36%)
No	146 (72.64%)

was 77.8%, 75.5%, 53.8%, and 90.2%. The diagnostic accuracy was 76.1%. (Table 2)

### Discussion

Thyroid USG is tremendously important in the estimation of a suspicious thyroid nodule. Identifying such nodules

is challenging for the radiologist which leads him to order FNAC for reaching a conclusive diagnosis. There are five characteristics for identifying malignancy in the suspicious thyroid nodules on radiography: 1. Calcification: micro and macro-calcifications<sup>8</sup>, 2. Hypoechoogenicity inside the thyroid nodule, 3. Irregular margins, 4. Consistency- nodules with

**Table 2.** Comparison of TI-RADS and FNAC for detection of thyroid nodules.

		FNAC		Total
		Positive	Negative	
TI-RADS	Positive	42	36	78
	Negative	12	111	123
Total		54	147	201
Sensitivity		77.8%		
Specificity		75.5%		
PPV		53.8%		
NPV		90.2%		
Diagnostic Accuracy		76.1%		

more solid tissue have higher chance of being malignant while the spongiform or cystic nodules are mostly considered benign<sup>9</sup>, and 5. Shape - a wider than taller nodule looks more benign than malignant and vice versa.<sup>10</sup>

A study conducted by Alam et al.<sup>11</sup> reported the sensitivity (91.7%) and specificity (78.94%) of USG separating the benign from malignant thyroid nodules. Their PPV and NPV was 57.9% and 96.8%. Overall accuracy was 82%. Another multicenter study was conducted by Trimboli et al.<sup>12</sup> who reported a higher sensitivity (93%) and NPV (96.8%) but lower specificity (67.9%) and PPV (48.2%) with the diagnostic accuracy of 74%. A study conducted by Macedo et al.<sup>13</sup> evaluated the diagnostic accuracy of TI-RADS for differentiating malignant and benign tumors and concluded that TI-RADS is 100% sensitive, 61.1% specific, 100% PPV, and 63% NPV. All these results are in concordance with the present study (Table 2).

## Conclusion

Differentiating benign thyroid from malignant thyroid nodules using the TI-RADS score has a high diagnostic accuracy. The study results support the TIRADS as a first-line imaging evaluation for the diagnosis of suspected thyroid malignancy.

## Limitations of the study

It was a single center study and clinical variables like duration of disease, size, and age of the patients were not correlated with the suspicion of thyroid malignancy. The study may be supplemented with possible future larger scale studies in order to strengthen the conclusions drawn about study topic under discussion.

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## List of Abbreviations

FNAC Fine needle aspiration cytology.  
NPV Negative predictive value.

PPV Positive predictive value.  
TI-RADS Thyroid imaging reporting and data system.  
USG Ultrasonography.

## Conflict of interests

None to declare.

## Grant support and financial disclosure

None to disclose.

## Ethical approval

The study was approved by the Institutional Ethical Review Committee vide Letter No. 0046-21/E.C/BAM&D.

## Authors' contribution

**SN, MZ:** Conception of study, acquisition, analysis of data, drafting the manuscript; **AMJ:** Intellectual input, critical review of the manuscript; **SA:** Acquisition and critical revision of data; **SA:** Conception of study, analysis of data; **UHK:** Acquisition of data, drafting the manuscript.

**ALL AUTHORS:** Approval of the final version of the manuscript to be published.

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