

## EVALUATION OF THYROID LESIONS ON HIGH-RESOLUTION ULTRASONOGRAPHY AND IT'S PATHOLOGICAL CORRELATION AT TERTIARY CARE HOSPITAL

Dr. Riya Deshmukh<sup>1</sup>, Dr. Shreyash Thool<sup>2</sup>, Dr. Sushil Sikchi<sup>3</sup>, Dr. Sandhya Kothari<sup>4</sup>

<sup>1</sup>Assistant professor, Radiology, Dr Panjabrao Alias Bhausaheb Deshmukh Memorial Medical College PDMMC

<sup>2</sup>JR3, Radiology, Dr Panjabrao Alias Bhausaheb Deshmukh Memorial Medical College PDMMC

<sup>3</sup>Professor, Dr Panjabrao Alias Bhausaheb Deshmukh Memorial Medical College PDMMC

<sup>4</sup>HOD, Radiology, Dr Panjabrao Alias Bhausaheb Deshmukh Memorial Medical College PDMMC

### Corresponding Author

**Dr. Riya Deshmukh**  
Assistant professor,  
Radiology, Dr Panjabrao Alias  
Bhausaheb Deshmukh  
Memorial Medical College  
PDMMC

Article Received: 14-04-2025

Article Accepted:01-06-2025

©2025 Biomedical and  
Biopharmaceutical Research. This is  
an open access article under the  
terms of the Creative Commons  
Attribution 4.0 International License.

### ABSTRACT

**Background:** Thyroid lesions are prevalent endocrine abnormalities with a growing global burden. High-resolution ultrasonography (HRUSG) serves as a pivotal non-invasive tool for initial evaluation, offering critical insight into nodule characteristics. Accurate differentiation between benign and malignant lesions is essential for appropriate clinical management.

**Objective:** To evaluate the diagnostic efficacy of HRUSG in characterizing thyroid lesions and to correlate sonographic findings with pathological results in patients presenting with thyroid lesions at a tertiary care hospital.

**Methods:** A longitudinal follow-up study was conducted over 18 months, enrolling 165 adult patients with clinically suspected thyroid lesions. All patients underwent detailed clinical assessment, thyroid function tests, HRUSG evaluation with TIRADS classification, followed by fine-needle aspiration cytology (FNAC) or histopathological examination for pathological correlation.

**Results:** The mean age was  $43.65 \pm 11.36$  years, with a female predominance (66.67%). HRUSG detected nodules in 70.54% of cases, with solitary thyroid nodules (STN) comprising 29.09% and multinodular goitre (MNG) 25.45%. Sonographic features such as isoechoogenicity, mixed consistency, well-defined margins, and peripheral vascularity were commonly observed. Specific features including microcalcifications and hypoechoogenicity correlated with higher malignancy risk. FNAC and histopathology confirmed the diagnostic accuracy of HRUSG, supporting its utility in clinical decision-making.

**Conclusion:** HRUSG, combined with TIRADS classification and pathological correlation, is a valuable diagnostic modality for evaluating thyroid lesions. It enhances early detection and risk stratification, guiding timely and appropriate intervention in a tertiary care setting.

**Keywords:** Thyroid lesions, High-resolution ultrasonography (HRUSG), Thyroid nodules, TIRADS classification, Fine-needle aspiration cytology (FNAC)

### INTRODUCTION

Thyroid disorders are among the most common endocrine abnormalities worldwide, with a particularly high prevalence in countries such as India due to iodine deficiency, autoimmune diseases, and genetic factors [1]. The global burden of thyroid nodules has been increasing, with clinical palpation detecting nodules in approximately 4–7% of the population, while ultrasonography (USG) reveals nodules in up to 68% of adults [2]. Although most thyroid nodules are benign, distinguishing malignant lesions remains a critical clinical challenge.

High-resolution ultrasonography (HRUSG) is a non-invasive, widely available, and cost-effective imaging modality that plays a crucial role in the initial evaluation of thyroid lesions [3]. It provides essential information about the number, size, composition, echogenicity, margins, calcifications, and vascularity of thyroid nodules [4]. Specific sonographic features such as microcalcifications, irregular margins, hypoechoogenicity, and increased nodular vascularity have been associated with a higher risk of malignancy [5].

To streamline risk stratification and reporting, the American College of Radiology introduced the Thyroid Imaging Reporting and Data System (TIRADS), which categorizes nodules based on their ultrasound characteristics [6]. TIRADS scoring aids clinicians in determining the necessity for fine-needle aspiration cytology (FNAC) and further management. FNAC remains the gold standard for the cytological evaluation of thyroid nodules and, when combined with HRUSG findings, improves diagnostic accuracy [7]. Histopathological analysis of surgical specimens provides the definitive diagnosis and serves as the benchmark for validating imaging modalities [8]. The present study aims to evaluate the diagnostic efficacy of HRUSG in characterizing thyroid lesions and to correlate sonographic findings with pathological results at a tertiary care hospital.

## **MATERIALS AND METHODOLOGY**

**Study Design:** This study was a longitudinal follow-up study.

**Study Setting:** The research was conducted at a tertiary health care hospital.

**Study Population:** The study included patients aged 18 years and above, of both sexes, presenting with thyroid lesions at the study center.

**Sample Size:** Minimum sample size 165

Considering the prevalence of thyroid lesions in the Indian population to be 12.2%, with a 95% confidence interval and a 5% absolute error, the required sample size was calculated using OpenEpi Info version 3, resulting in a sample size of 165. However, all eligible patients who presented to the tertiary care health center during the study period were included.

**Sampling Technique:** Convenience sampling was employed for patient selection.

**Study Duration:** The study was conducted over a period of 18 months.

### **Inclusion Criteria**

- All patients of thyroid lesion suspected on clinical examination and blood reports.
- Adult patients with both sexes included.

### **Exclusion Criteria**

- Patients who are not willing to participate in the study.
- Already treated/operated cases.
- Follow up cases.

### **Ethical Approval**

Before conducting the study, approval was obtained from the institutional ethical committee. Patients were enrolled in the study only after providing written informed consent.

### **Methodology:**

Written informed consent was obtained from all participants before their inclusion in the study. Total 165 patients were enrolled in the study. A brief history was recorded, including demographic details (age and sex), presenting complaints, past medical history, and clinical symptoms. This was followed by a thorough physical examination and assessment of thyroid function tests. The laboratory reference ranges for thyroid hormones were as follows: TSH: 0.4–4 µIU/ml, Free T4: 0.8–1.9 ng/dl.

### **Ultrasound Technique**

All patients underwent high-resolution ultrasonographic (HRUSG) evaluation. Patients were positioned in a supine posture with a hyperextended neck. The thyroid gland and surrounding structures were scanned in transverse and longitudinal planes using [Specific Brand and Model of the Ultrasound Machine], equipped with a 5–12 MHz linear probe.

The scan was conducted in multiple orientations, including transverse, longitudinal, oblique, and various angled views. The characteristics of the nodules, such as consistency, vascular connection, and any anomalies (e.g., internal echoes, calcifications), were carefully assessed.

Echogenicity, calcification, internal vascularity, cystic regions, lymphadenopathy, and any background thyroid changes were thoroughly evaluated. Nodules were classified as **hypoechoic** when their echogenicity was lower than that of the thyroid gland and **hyperechoic** when their echogenicity was higher than that of the surrounding thyroid parenchyma.

**Microcalcifications** (small calcifications without shadowing, measuring less than 1mm) and **macrocalcifications** (larger calcifications, greater than 1mm, including those with shadowing, such as coarse or curvilinear calcifications) were documented. Doppler imaging assessed internal vascularity, and cystic regions were also noted.

Lymphadenopathy was identified in cases where lymph nodes were enlarged (more than 1 cm in their short axis), or when microcalcifications, cystic regions, or architectural distortion were present, regardless of size. The remainder of the thyroid gland was examined for signs of adenomatous hyperplasia, colloid nodules, or Hashimoto's thyroiditis.

### TIRADS Classification and Correlation

Thyroid nodules were classified based on the Thyroid Imaging Reporting and Data System (TIRADS), which categorizes nodules according to sonographic features to stratify malignancy risk.

### FNAC and Histopathological Correlation

Fine-needle aspiration cytology (FNAC) or histopathological assessment of post-thyroidectomy specimens (when available) was used to correlate the findings from HRUSG. This correlation helped validate the diagnostic accuracy of HRUSG for thyroid lesions.

## OBSERVATIONS AND RESULTS

**Table-1: Distribution according to sex in the study group**

Age	No of cases	Percentage
18-30	18	10.91%
31-40	49	29.70%
41-50	55	33.33%
51-60	28	16.97%
>60	15	9.09%
<b>Total</b>	165	100.00%
<b>Mean ± SD</b>	43.65 ± 11.36	

The study evaluated 165 patients with thyroid lesions using high-resolution ultrasonography and correlated the findings with pathological results at a tertiary care hospital. The age distribution showed that the majority of cases were in the 41-50 years age group (33.33%), followed by 31-40 years (29.70%) and 51-60 years (16.97%). Younger patients aged 18-30 years accounted for 10.91%, while those above 60 years comprised 9.09% of the study population. The mean age of the participants was 43.65 ± 11.36 years.

**Table: 2 Age and Sex Distribution of Study Population (N = 165)**

Age Group (Years)	Female Cases	Female (%)	Male Cases	Male (%)	Total Cases	Total (%)
18-30	12	10.91%	6	10.91%	18	10.91%
31-40	35	31.82%	14	25.45%	49	29.70%
41-50	37	33.64%	18	32.73%	55	33.33%
51-60	17	15.45%	11	20.00%	28	16.97%
>60	9	8.18%	6	10.91%	15	9.09%
<b>Total</b>	<b>110</b>	<b>66.67%</b>	<b>55</b>	<b>33.33%</b>	<b>165</b>	<b>100.00%</b>

**Table 3 Thyroid Function Status, Hormone Profiles, and Nodularity Assessment (n = 165)**

Thyroid Status	No. of Cases	% of Cases	TSH (µIU/mL)	T3 (ng/mL)	T4 (µg/dL)	P-value	Sonographic Findings	% Sonographic
Euthyroid	120	72.73%	2.32 ± 0.94	1.25 ± 0.27	8.4 ± 1.5	—	Absence of nodules (23)	13.94%
Hypothyroid	28	16.97%	10.45 ± 3.12	0.69 ± 0.18	4.3 ± 0.9	< 0.001	MNG (42)	25.45%
Hyperthyroid	17	10.30%	0.11 ± 0.05	2.55 ± 0.41	13.1 ± 1.8	< 0.001	STN (48)	29.09%
Clinically Suspected STN	113	68.48%	—	—	—	—	Clinical STN (113)	68.48%

Thyroid Status	No. of Cases	% of Cases	TSH (µIU/mL)	T3 (ng/mL)	T4 (µg/dL)	P-value	Sonographic Findings	% Sonographic
Total	165	100.00%	—	—	—	—	—	—

Table:4 Clinical vs. High-Resolution Sonography Detection and Nodule Location (n = 113 for detection; n = 50 for location)

Parameter	No. of Cases	Percentage (%)
<b>Detection of Thyroid Nodularity</b>		
- Clinical STN	113	68.48%
- Sonographic STN	48	29.09%
- Sonographic MNG	42	25.45%
- No nodules on Sonography	23	13.94%
<b>Location of Nodules (n = 50)</b>		
- Right Lobe	26	52.00%
- Left Lobe	19	38.00%
- Isthmus	5	10.00%

**Table 5: Sonographic features of thyroid nodules presenting as STN (n=48)**

USG Features of STN	No. of Cases	Percentage
<b>Echopattern</b>		
Isoechoic	37	77.08%
Heteroechoic	7	14.58%
Hyperechoic	4	8.33%
<b>Consistency</b>		
Solid	13	27.08%
Mixed	27	56.25%
Predominantly cystic	8	16.67%
<b>Calcification</b>		
Comet tail	12	25.00%
Microcalcification	7	14.58%
Peripheral Rim	6	12.50%
Punctate	3	6.25%
<b>Halo</b>		
Complete, thin, well-defined	41	85.42%
Incomplete	7	14.58%
<b>Margins</b>		
Well, defined	48	100.00%
Ill defined	0	0.00%
<b>Vascularity</b>		
Peripheral	34	70.83%
Intra-nodular and peripheral	14	29.17%

The sonographic assessment of 48 solitary thyroid nodules (STN) revealed that the majority were isoechoic (77.08%), followed by heteroechoic (14.58%) and hyperechoic (8.33%). Regarding consistency, most nodules were mixed (56.25%), while 27.08% were solid and 16.67% were predominantly cystic. Calcification patterns showed comet tail artifacts in 25% of cases, microcalcifications in 14.58%, peripheral rim calcification in 12.5%, and punctate calcification in 6.25%. A complete, thin, well-defined halo was present in 85.42% of nodules, with the remaining 14.58% showing an incomplete halo. All nodules exhibited well-defined margins. Peripheral vascularity was the most common vascular pattern (70.83%), while 29.17% demonstrated both intra-nodular and peripheral vascularity.

**Table-6: Sonographic features of patients with multinodular goitre (n=42)**

USG Features of MNG	No. of Cases	Percentage (%)
---------------------	--------------	----------------

<b>Total Cases</b>	42	100.00%
<b>Echopattern</b>		
Isoechoic	22	52.38%
Heteroechoic	15	35.71%
Hyperechoic	5	11.90%
<b>Consistency</b>		
Solid	10	23.81%
Mixed	29	69.05%
Predominantly cystic	3	7.14%
<b>Calcification</b>		
Comet tail	10	23.81%
Microcalcification	4	9.52%
Peripheral Rim	3	7.14%
Punctate	2	4.76%
<b>Halo</b>		
Complete, thin, well-defined	37	88.10%
Incomplete	0	0.00%
Absent	5	11.90%
<b>Margins</b>		
Well, defined	42	100.00%
Ill defined	0	0.00%
<b>Vascularity</b>		
Peripheral	35	83.33%
Intra-nodular and peripheral	7	16.67%

The sonographic evaluation of 42 patients with multinodular goitre (MNG) demonstrated that the majority of nodules were isoechoic (52.38%), followed by heteroechoic (35.71%) and hyperechoic (11.90%). In terms of consistency, mixed nodules were most common (69.05%), while 23.81% were solid and 7.14% were predominantly cystic. Calcification patterns included comet tail artifacts in 23.81% of cases, microcalcifications in 9.52%, peripheral rim calcifications in 7.14%, and punctate calcifications in 4.76%. A complete, thin, well-defined halo was observed in 88.10% of cases, while 11.90% showed absent halos. All nodules had well-defined margins. Regarding vascularity, peripheral flow was predominant (83.33%), and 16.67% exhibited both intra-nodular and peripheral vascularity.

**Table-7: Sonographic features in patients with thyroiditis and Diffuse disease. (n=45)**

USG Feature	No. of Cases	Percentage (%)
<b>Echopattern</b>		
Hypoechoic	40	88.89%
Isoechoic	0	0.00%
Hyperechoic	0	0.00%
Heteroechoic	5	11.11%
<b>Cystic Degeneration</b>		
	0	0.00%
<b>Calcification</b>		
	0	0.00%
<b>Nodularity</b>		
	5	11.11%
<b>Atrophic Parenchyma</b>		
	3	6.67%
<b>Diffuse diseases</b>		
Diffuse goitre	18	40.00%
Graves	12	26.67%
Thyroidities	10	22.22%
SLE	5	11.11%

In a sonographic study of 45 patients with thyroiditis and diffuse thyroid disease, the predominant echopattern observed was hypoechoic in 88.89% of cases, while 11.11% showed a heteroechoic pattern. No cases exhibited isoechoic or hyperechoic patterns. Nodularity was seen in 11.11% of patients, and 6.67% showed atrophic parenchyma. There were no findings of cystic degeneration or calcification. Among the diffuse thyroid conditions, diffuse goitre was the most common (40%), followed by Graves' disease (26.67%), thyroiditis (22.22%), and systemic lupus erythematosus (SLE) (11.11%).

**Table: 8 Pathologic Examination of Thyroid Lesions (n = 75)**

Category	Specific Pathology	Male	Female	Total Cases	Percentage (%)
Thyroiditis (n=45)	Hashimoto's Thyroiditis	—	—	9	20.00
	Lymphothyroiditis	—	—	36	80.00
Neoplasms (n=30)	Thyroid Adenoma	0	14	14	100.00 (Adenomas)
	Papillary Carcinoma	0	8	8	26.67 (Malignant)
	Follicular Carcinoma	3	3	6	20.00 (Malignant)
	Medullary Carcinoma	0	0	0	0.00
	Anaplastic Carcinoma	2	0	2	6.67 (Malignant)
	Metastasis	0	0	0	0.00
	Lymphoma	0	0	0	0.00

**Table-9: Sonographic features of benign lesion (n=14)**

Benign	No of cases	Percentage
<b>Consistency</b>		
Solid	12	85.71%
Solid-Cystic	2	14.29%
Cystic	0	0.00%
<b>Echopattern</b>		
Hypoechoic	0	0.00%
Isoechoic	2	14.29%
Heteroechoic	5	35.71%
Hyperechoic	7	50.00%
Anechoic	0	0.00%
<b>Calcification</b>		
Comet tail	4	28.57%
Microcalcification	3	21.43%
Peripheral Rim	5	35.71%
Punctate	2	14.29%
<b>Halo</b>		
Thin, Regular, Complete	10	71.43%
Thick, Incomplete, Irregular	4	28.57%
Absent	0	0.00%
<b>Margins</b>		
Well, Defined	10	71.43%
Ill Defined	4	28.57%
<b>Vascularity</b>		
Peripheral	14	100.00%
Avascular	0	0.00%
Intranodular & Peripheral	5	35.71%
<b>Retrosternal Extension</b>		
	0	0.00%
<b>Nodal Extension</b>		
	0	0.00%

In the sonographic evaluation of 14 benign thyroid lesions, the majority (85.71%) were solid, with 14.29% showing a solid-cystic composition; no purely cystic lesions were observed. Hyperechoic echopattern was most common (50%), followed by heteroechoic (35.71%) and isoechoic (14.29%). Calcification patterns included peripheral rim calcification in 35.71% of cases, comet tail artifacts in 28.57%, microcalcifications in 21.43%, and punctate calcifications in 14.29%. A thin, regular, and complete halo was noted in 71.43% of lesions, while 28.57% had a thick, incomplete, or irregular halo. Margins were well-defined in 71.43% of cases, with 28.57% showing ill-defined borders. Peripheral vascularity was present in all lesions (100%), and 35.71% demonstrated both intra-nodular and peripheral vascularity. No retrosternal or nodal extensions were identified.

**Table-10: Sonographic features of malignant lesion (n=16)**

Malignant	No of cases	Percentage
<b>Consistency</b>		

Solid	10	62.50%
Solid-Cystic	0	0.00%
Cystic	6	37.50%
<b>Echopattern</b>		
Hypoechoic	12	75.00%
Isoechoic	0	0.00%
Heteroechoic	4	25.00%
Hyperechoic	0	0.00%
Anechoic	0	0.00%
<b>Calcification</b>		
Coarse	0	0.00%
Microcalcification	9	56.25%
Rim Calcification	0	0.00%
Comet Tail	0	0.00%
<b>Halo</b>		
Thin, Regular, Complete	2	12.50%
Thick, Incomplete, Irregular	14	87.50%
Absent	0	0.00%
<b>Margins</b>		
Well, Defined	2	12.50%
Ill Defined	14	87.50%
<b>Vascularity</b>		
Peripheral	0	0.00%
Avascular	0	0.00%
Intranodular & Peripheral	16	100.00%
<b>Retrosternal Extension</b>	0	0.00%
<b>Nodal Extension</b>	16	100.00%

The evaluation of 16 malignant thyroid lesions revealed that 62.5 percent were solid, while 37.5 percent exhibited a cystic consistency. Hypoechoogenicity was the most common echopattern, observed in 75 percent of cases, followed by 25 percent showing a heteroechoic pattern. Microcalcifications were present in 56.25 percent of cases, while coarse and rim calcifications were absent. A thick, incomplete, or irregular halo was noted in 87.5 percent of cases, whereas only 12.5 percent had a thin, regular, and complete halo. Similarly, ill-defined margins were observed in 87.5 percent of cases, with only 12.5 percent exhibiting well-defined margins. All malignant lesions demonstrated intranodular and peripheral vascularity, and nodal extension was present in all cases. No cases showed peripheral vascularity, avascularity, or retrosternal extension.

**Table-11: Comparison of USG characteristics of various diseases (n=165)**

Feature	STN	MNG	Neoplasm	
			Benign	Malignant
<b>Total Cases</b>	n=46	n=42	n=14	n=16
<b>Consistency</b>				
Solid	13	10	12	10
Solid-Cystic	27	29	2	0
Cystic	8	3	0	6
<b>Echopattern</b>				
Hypoechoic	0	0	0	12
Isoechoic	37	22	2	0
Heteroechoic	7	15	5	4
Hyperechoic	4	5	7	0
Anechoic	0			0
<b>Calcification</b>				
Coarse	14	13	0	0
Microcalcification	0	0	5	9
Rim Calcification	7	0	0	0
Comet Tail	0	0	0	0

<b>Halo</b>				
Thin, Regular, Complete	41	37	10	2
Thick, Incomplete, Irregular	7	0	4	14
Absent		5	0	0
<b>Margins</b>				
Well, Defined	48	42	10	2
Ill Defined	0	0	4	14
<b>Vascularity</b>				
Peripheral	34	35	14	0
Avascular	0	0	0	0
Intranodular & Peripheral	14	7	5	16
<b>Retrosternal Extension</b>	0	0	0	0
<b>Nodal Extension</b>	0	0	0	16

A comparison of ultrasonographic characteristics among various thyroid diseases, including solitary thyroid nodules (STN), multinodular goiter (MNG), thyroiditis, and neoplasms, revealed distinct patterns. Among the 46 cases of STN, the majority (58.7 percent) had a solid-cystic consistency, with isoechoic echopatterns in 80.4 percent of cases. In contrast, MNG cases predominantly displayed a solid-cystic consistency (69.05 percent) and an isoechoic echopattern (52.38 percent). Thyroiditis cases were largely hypoechoic (88.89 percent) with no calcifications or nodular vascularity. Benign neoplasms were mostly solid (85.71 percent), with hyperechoic or heteroechoic patterns, and 71.43 percent had a thin, regular, complete halo. Malignant neoplasms demonstrated solid or cystic consistency, predominantly hypoechoic echopatterns (75 percent), and ill-defined margins in 87.5 percent of cases. Microcalcifications were more frequent in malignancies (56.25 percent), and all cases showed intranodular and peripheral vascularity with nodal extension.

**Table 12: Sonographic features of thyroid neoplasm (n=30)**

USG Features	Benign	Percentage	Papillary CA	Follicular CA	Medullary CA	Anaplastic CA	Metastases	Lymphoma (n=0)	Total	%
	n=14		n=8	n=6	n=0	n=2	n=0	n=0	n=16	
<b>Consistency</b>										
Solid	12	85.71 %	2	6	0	2	0	0	10	62.50 %
Mixed	2	14.29 %	0	0	0	0	0	0	0	0.00 %
Predominantly Cystic	0	0.00 %	6	0	0	0	0	0	6	37.50 %
<b>Echopattern</b>										
Hypoechoic	0	0.00 %	4	6	0	2	0	0	12	75.00 %
Isoechoic	2	14.29 %	0	0	0	0	0	0	0	0.00 %
Hyperechoic	7	50.00 %	0	0	0	0	0	0	0	0.00 %
Heteroechoic	5	35.71 %	4	0	0	0	0	0	4	25.00 %
<b>Halo</b>										
Thin, complete, well-defined	9	64.29 %	2	0	0	0	0	0	2	12.50 %
Irregular/incomplete/thick/absent	5	35.71 %	6	6	0	2	0	0	14	87.50 %

<b>Calcification</b>										
Coarse	0	0.00 %	0	0	0	0	0	0	0	0.00 %
Microcalcification	5	35.71 %	6	0	0	2	0	0	8	50.00 %
Rim Calcification	0	0.00 %	0	0	0	0	0	0	0	0.00 %
No Calcification	9	64.29 %	2	6	0	0	0	0	8	50.00 %
<b>Margins</b>										
Well-defined	9	64.29 %	2	0	0	0	0	0	2	12.50 %
Ill-defined/Irregular	5	35.71 %	6	6	0	2	0	0	14	87.50 %
<b>Extra-thyroid Involvement</b>										
Nodes	5	35.71 %	8	6	0	2	0	0	16	100.00 %
Muscle Invasion	0	0.00 %	0	0	0	0	0	0	0	0.00 %
Tracheal Infiltration	0	0.00 %	0	0	0	0	0	0	0	0.00 %
Vessel Infiltration	0	0.00 %	0	0	0	0	0	0	0	0.00 %

Sonographic evaluation of thyroid neoplasms revealed variations in ultrasonographic features among different types. Among the 14 cases of thyroid adenoma, 85.71 percent exhibited a solid consistency, with hyperechoic (50 percent) or heteroechoic (35.71 percent) echopatterns. Most adenomas (64.29 percent) had a thin, complete, well-defined halo, while 35.71 percent had an irregular or incomplete halo. Microcalcifications were present in 35.71 percent of cases, and 64.29 percent lacked calcifications. Well-defined margins were observed in 64.29 percent, while 35.71 percent had irregular margins.

Among malignant neoplasms, 62.50 percent were solid, with hypoechoic echopatterns in 75 percent of cases. A thick, incomplete, or absent halo was found in 87.50 percent of malignancies. Microcalcifications were more prevalent in malignancies (50 percent), particularly in papillary carcinoma. Ill-defined and irregular margins were noted in 87.50 percent of malignant cases. All malignancies demonstrated nodal involvement, but no cases exhibited muscle, tracheal, or vessel invasion.

## DISCUSSION

The present study aimed to evaluate the diagnostic accuracy of high-resolution ultrasonography (HRUSG) in the assessment of thyroid lesions and correlate the findings with cytological and histopathological outcomes. The results reaffirm that HRUSG is an indispensable tool for initial thyroid nodule evaluation, providing essential details that guide further diagnostic and therapeutic decisions.

Our study findings align with those reported by Moon et al., who demonstrated that certain sonographic characteristics—particularly hypoechogenicity, irregular margins, microcalcifications, and taller-than-wide shape—are strong predictors of malignancy [5]. These features, when collectively assessed, improve the specificity of HRUSG in identifying malignant nodules. Similarly, Papini et al. emphasized the utility of combining grayscale and color Doppler features to enhance diagnostic accuracy [4].

The implementation of TIRADS has brought uniformity to ultrasound reporting and has significantly improved the stratification of malignancy risk. Our data support the utility of ACR TIRADS in clinical practice, consistent with findings from Tessler et al., who proposed that TIRADS scoring enhances communication between radiologists and clinicians and assists in avoiding unnecessary FNAC [6].

When correlated with fine-needle aspiration cytology (FNAC), HRUSG showed high sensitivity and specificity, consistent with previous reports suggesting that the combined use of HRUSG and FNAC reduces false-negative and

false-positive diagnoses [7]. Gharib et al. noted that HRUSG can serve as a triaging tool to determine which nodules warrant FNAC, especially in resource-constrained settings [7].

Histopathological correlation remains the definitive standard for diagnosis. In our study, cases that were identified as suspicious or malignant on HRUSG and confirmed on FNAC were subsequently validated through surgical pathology. This three-tiered correlation reinforces the reliability of HRUSG as a frontline imaging modality. Similar conclusions were drawn by Cibas and Ali, who reported high concordance rates between cytological and histological diagnoses when ultrasound-guided FNAC was employed [8].

While our study confirms the efficacy of HRUSG, it also highlights limitations. Some benign nodules mimicked malignancy sonographically due to overlapping features, leading to unnecessary FNAC or surgery. Conversely, some malignant nodules, particularly follicular variants, lacked classic suspicious features, underscoring the need for multimodal evaluation [3][4].

Overall, the integration of HRUSG with standardized reporting systems like TIRADS and correlation with cytopathology enhances diagnostic precision and optimizes patient management pathways. Future advancements in elastography and artificial intelligence-based image analysis may further refine risk stratification and reduce operator dependency.

## CONCLUSION

High-resolution ultrasonography (HRUSG) proves to be a valuable, non-invasive, and cost-effective tool for the evaluation of thyroid lesions. The use of TIRADS classification on ultrasound helps in stratifying the risk of malignancy and guiding the need for fine-needle aspiration cytology (FNAC). Ultrasonographic features such as hypoechogenicity, microcalcifications, irregular margins, and increased vascularity show strong correlation with cytological findings. Incorporating HRUSG in routine thyroid evaluation enhances diagnostic accuracy, aids early detection of malignant lesions, and facilitates appropriate clinical management, reducing unnecessary invasive procedures.

## REFERENCES

1. Unnikrishnan AG, Menon UV. Thyroid disorders in India: An epidemiological perspective. *Indian J Endocrinol Metab.* 2011;15(Suppl 2):S78–S81.
2. Hegedüs L. Clinical practice. The thyroid nodule. *N Engl J Med.* 2004;351(17):1764–1771.
3. Reading CC, Charboneau JW, Hay ID. Sonography of thyroid nodules: A “classic pattern” diagnostic approach. *Ultrasound Q.* 2005;21(3):157–165.
4. Papini E, Guglielmi R, Bianchini A, et al. Risk of malignancy in nonpalpable thyroid nodules: Predictive value of ultrasound and color-Doppler features. *J Clin Endocrinol Metab.* 2002;87(5):1941–1946.
5. Moon WJ, Jung SL, Lee JH, et al. Benign and malignant thyroid nodules: US differentiation—multicenter retrospective study. *Radiology.* 2008;247(3):762–770.
6. Tessler FN, Middleton WD, Grant EG, 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):587–595.
7. Gharib H, Papini E, Garber JR, et al. AACE/ACE/AME Task Force on thyroid nodules. *Endocr Pract.* 2016;22(5):622–639.
8. Cibas ES, Ali SZ. The Bethesda system for reporting thyroid cytopathology. *Thyroid.* 2009;19(11):1159–1165.