



# Diagnostic Accuracy of Ultrasound in Detecting Malignant Thyroid Nodules Keeping Histopathology as Gold Standard

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## Article Info

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## Abstract

**Objective:** To determine the diagnostic accuracy of ultrasound in the detecting malignant thyroid nodule keeping histopathology as a gold standard.

**Methodology:** In the current study a total of 164 patients were included. A detail history, routine hospital investigations and physical examination for the included patients were performed. Patients were subjected to ultrasound in Radiology department where the ultrasound was done by the senior resident under the supervision of expert radiologist having more than 7 years of experience. The nodules were reported according to ACR TI-RADS. Then the patients were referred to ENT department where the incisional biopsy were performed and the specimen was sent to hospital laboratory for the diagnosis of malignant thyroid nodule. All the histopathological examinations were done by expert histopathologist having more than 7 years of experience.

**Results:** In this study total 164 patients were included and mean age was 34 years with SD  $\pm$  7.318. Male patients were 62(38%) while 102(62%) patients were female. Ultrasound had sensitivity 96.58%, specificity 83.33%, positive predictive value 76.65%, negative predictive value 97.72% and the diagnostic accuracy was 88.12%.

**Conclusion:** Our study concludes that ultrasound had sensitivity 96.58%, specificity 83.33%, positive predictive value 76.65%, negative predictive value 97.72% and the diagnostic accuracy was 88.12% in the detecting malignant thyroid nodule keeping histopathology as a gold standard.

**Keywords:** diagnostic accuracy, ultrasound, malignant thyroid nodule, histopathology



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## Introduction

Thyroid gland nodules are commonly present in the general population, particularly females and has increasing incidence, however the incidence of malignancy in all thyroid nodules is about 5%-30%.<sup>1</sup> The increasing diagnosis of thyroid malignancy is due to the vast use of radiological imaging and easy access to health facility and as a result small, subclinical thyroid nodules are easily detected. However there is increasing costs and morbidity related to management of patients with thyroid nodules.<sup>2,3</sup>

Although incidence of thyroid malignancy has increased worldwide however, rate of mortality has remained stable at lower rates and this is due to an overdiagnosis of the disease.<sup>4</sup>

The advancement of diagnostics and management plans of thyroid malignancy in past few years has revolutionized the care of patients.<sup>5</sup> Color Doppler Ultrasonography is the primary imaging modality for detecting the thyroid nodule and assessing the risk of cancer in it. Thyroid imaging reporting and data system (TIRADS) is used for reporting thyroid nodule in ultrasound and to decide whether to proceed for a fine-needle aspiration biopsy.<sup>6</sup> An ultrasound report should document about size of nodule, its site, ultrasonography features, background thyroid parenchyma and a status of the lymph nodes in neck.<sup>7</sup> Ultrasound features like micro calcifications; hypo echogenicity; irregularity, micro lobulations, infiltrative margins and taller-than-wide shape has high risk of malignancy.<sup>8</sup>

The location of the nodule in thyroid gland is also risk factor of malignancy. It has been documented that nodules in the isthmus has high risk of malignancy while nodules in the lower third of a lobe has the lowest risk as compared to nodules in upper pole and middle of the lobe.<sup>9,10</sup>

Thyroid malignancies are confirmed by fine-needle aspiration biopsy (FNAB) or excisional biopsy with Follicular adenomas most common on histopathology. Follicular adenomas are commonly encapsulated, with no evidence of infiltrative features.<sup>11</sup> The common malignancies detected in the thyroid gland are follicular carcinoma, papillary carcinoma, anaplastic carcinoma, and medullary cancer. Nuclear imaging may not be necessary in thyroid nodules if TSH levels are normal, and should be proceeded with FNA biopsy.<sup>12</sup> The fine needle aspiration cytology (FNAC) has high accuracy to detect malignant nodule and unnecessary surgery for benign nodules can be avoided.<sup>1</sup>

The main purpose of this study is to assess the diagnostic accuracy of ultrasonography in detecting malignant thyroid gland nodule taking histopathology as gold standard. Although few study has already been conducted on the same topic in other population but no such study has been done in our population for the last

five years so the current study will provide the updated and latest information regarding diagnostic accuracy of ultrasound in detecting malignant thyroid nodule in our local population. This study results will be shared with other health professionals to draw future recommendations about routine use of ultrasonography to confirm the thyroid nodule malignancy.

## Methodology

The current study was conducted at Department of Radiology, Hayatabad Medical Complex It was descriptive (cross sectional) study. The duration of study was six months duration from 29/1/2021 to 29/7/2021. A sample size of 164 was taken, using sensitivity of ultrasound 81.2% and specificity of 88.2%, 95% confidence level, 10% absolute precision and 36.17% proportion of thyroid nodule malignancy. Consecutive (non-probability) sampling was used.

Inclusion criteria included patients presenting with solitary thyroid nodule with high suspicion of malignancy on clinical examination and duration of disease more than 6 months. Patients in age between 20-50 years of either gender (male/female) were considered. Those patients with known thyroid disease, multiple thyroid nodules and with neck abscess were excluded from the study.

Approval of the ethical committee of the hospital was sought. All those patients fulfilling the inclusion criteria were enrolled in the study through OPD and Department of Radiology, Hayatabad Medical Complex Peshawar. The purpose of this study and its procedure was explained to enrolled patients. Written consent was taken from all patients.

A detail history, routine hospital investigations and physical examination for the included patients was performed. Few patients had symptoms of abnormal thyroid hormone levels. The important symptoms considered were dysphagia and hoarseness which raised the suspicion of local infiltration of malignancy. Physical examination was done as benign nodules are commonly soft, mobile and non-tender while hard fixed, nodule, and loco-regional lymphadenopathy is associated with malignancy.<sup>13</sup>

Patients were subjected for ultrasound to Radiology department where the ultrasound was done by the trainee under the supervision of expert radiologist having more than 7 years of experience. The nodules were characterized and reported according to ACR TIRADS. The TI-RADS 1 and 2 nodules were considered benign while TI-RAD 3, 4 and 5 were suspected for malignancy. Then the patients were referred to ENT department where the incisional biopsy of thyroid nodule was performed and the specimen was sent to hospital laboratory for the diagnosis of malignant thyroid nodule. All the histopathological examinations were done by expert histopathologist having more than 7

years of experience.

Data including age, gender, duration of disease, type of nodular, site of nodule were recorded in a pre-diagnosed proforma.

All the documented data was analyzed on SPSS version 22. We calculated Mean and standard deviation for numerical variables like age and duration of disease. Frequency and percentages was calculated for categorical variables like gender, type of nodular status, site of nodule, ultrasound findings, and histo-pathological findings. Sensitivity, specificity, PPV, NPV and diagnostic accuracy was calculated by using 2x2 table. Value of 0.05 as statistically significant was considered level of significance.

## Results

Age distribution was analyzed in total 164 patients and it was found that most of the patients 120(73%) were in age group of 31-50 yrs. while 44(27%) patients were in age group of 20-30 yrs. .Mean age was 34 yrs. with SD ± 7.318. Among 164 patients, female gender was

common 102(62%) while males were 62(38%). Ultrasound findings among 164 patients was analyzed as ultrasound findings were positive (TI-RAD 3,4 and 5) in 144(88%) patients and was negative (TI-RADS 1 and 2) in 20(12%) patients. Histopathological findings among 164 patients were analyzed as histopathological findings were positive for malignancy in 146(89%) patients and were negative in 18(11%) patients (Table 1).

Diagnostic accuracy of ultrasound findings keeping histopathology was among as sensitivity was 96.58%, specificity was 83.33%, positive predictive value was 76.65%, negative predictive value was 97.72% and the diagnostic accuracy was 88.12% (Table 2).

## Discussion

Nodules in thyroid gland can be solid or cystic and are usually asymptomatic. However nodules that is large in size has effect on respiratory and cardiovascular systems.<sup>14</sup> Thyroid nodules are categorized in benign and malignant nodules. Benign nodules in thyroid gland are usually asymptomatic, small in size and has bet-

**Table 1. Baseline Characteristics(n=164)**

Variables		Frequency	percentage
Gender	Male	62	37.8
	Female	102	62.2
Age Groups (Years)	20-30 yrs	44	26.8
	31-50 yrs	120	73.2
	Mean Age in yrs	34	
Malignant nodules on Ultrasound	Positive	144	87.8
	Negative	20	12.2
Malignant nodules on Histopathology	Positive	146	89
	Negative	18	11

**Table 2. Diagnostic Accuracy**

		Malignant Nodules on Histopathology		Total	statistics
		Positive	Negative		
Malignant Nodules on Ultrasound	Positive	141	3	144	P value < 0.001 Sensitivity =96.58% Specificity =83.33% NPV =97.72% PPV=76.65% Diagnostic Accuracy=88.12%
		96.6%	16.7%	87.8%	
	Negative	5	15	20	
		3.4%	83.3%	12.2%	
Total		146	18	164	
		100.0%	100.0%	100.0%	

ter outcome. It is therefore necessary to determine the exact nature of nodule for effective management plan and better prognosis.<sup>15,16</sup>

Different imaging modalities used these days to characterize the nature of thyroid nodule are ultrasonography, CT scan and nuclear scintigraphy. Ultrasound is commonly used imaging modality as its safe, easily available with less cost and no radiations.<sup>17</sup> Irregular margins, calcifications, low echogenicity and heterogeneity of thyroid nodule on ultrasonography raise the suspicion of malignancy on ultrasound. However ultrasonography has limited role in diagnosing thyroid cancer in small nodule, multiple nodules, and hemorrhagic cystic nodules. Also sometimes thyroid nodules are not evident on ultrasonography.<sup>18</sup>

The reported sensitivity and specificity of US in detecting thyroid malignancy is 81.2% and 88.2%,<sup>19</sup> 88.4% and 91.7% with overall prevalence of cancer in thyroid nodules was 36.17% and benign nodules was 63.83%.<sup>20</sup> Ultrasonography has a high sensitivity to detect nodules in thyroid gland that are impalpable due to their small size. However, these small nodules are of indeterminate significance clinically.<sup>8</sup> The American College of Radiology (ACR) Thyroid Imaging Reporting and Data System (TI-RADS) which predict the risk of malignancy in the thyroid nodule on ultrasound features has a high specificity and decrease the number of unnecessary biopsies by 19.9–46.5%.<sup>21</sup>

The current study revealed that among 164 patients mean age was 34 years with SD  $\pm$  7.318. 62(38%) patients were male and 102(62%) patients were female. Ultrasound had sensitivity 96.58%, specificity 83.33%, positive predictive value 76.65%, negative predictive value 97.72% and the diagnostic accuracy was 88.12%.

Similar results were found in study done by Watanabe K et al<sup>22</sup> in which Ultrasound had high sensitivity of (81.2%), specificity of (88.2%), and positive (96.6%) and negative (53.6%) predictive values than TI/Tc scintigraphy. The macro calcifications and irregular margins were indicative of a cancer in thyroid nodule on multivariate logistic regression (P = 0.003 and P = 0.014, respectively). The specificity of persistent pattern was high (85.7%) like Ultrasound however sensitivity was low (34.7%).

Similarly our study results are comparable to the study done by Nawaz S et al<sup>23</sup> who also found diagnostic accuracy of ultrasound in thyroid nodules to be 94.2%

However our study results are in contrast to the study done by Al-Ghanimi et al,<sup>24</sup> who found that ultrasonography has high specificity of 94.9% in diagnosing benign nodule. The most likely reasons are that this study was done on small group of patients, secondly only benign nodules ultrasonographic features were noted and ultrasound results were compared with fine needle aspiration cytology (FNAC).

There are some limitations in the study. The sample

size of study was small. Secondly data was collected and analyzed from single center. Other demographic variables like family history, radiation exposure, socioeconomic status and iodine deficiency were not evaluated in the study. So future studies with large sample and multicenter data should be done. The other risk factors for thyroid malignancy should also be considered in further studies.

## Conclusion:

Ultrasound is readily available and cost effective imaging modality. Our study concludes that ultrasound has high diagnostic accuracy and sensitivity in differentiating between benign and malignant thyroid nodules. High resolution ultrasound helps in selection of thyroid nodule for biopsy and thus invasive FNAC biopsies and diagnostic operations can be reduced.

## References

1. Bchir A, Bdioui A, Zammel H, Missaoui N, Hmissa S, Mokni M. The importance of using fine-needle aspiration cytology in the diagnosis of thyroid nodules. *Ann Med surg.* 2021; 26(4):102-18
2. Ramundo V, Sponziello M, Falcone R. Low-risk papillary thyroid microcarcinoma: optimal management toward a more conservative approach. *J Surg Oncol.* 2020;121(6):958-63.
3. Filetti S, Durante C, Hartl D. Thyroid cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. *Ann Oncol.* 2019;30(12):1856-63.
4. Pizzato M, Li M, Vignat J, Laversanne M, Singh D, Vecchia CL et al. The epidemiological landscape of thyroid cancer worldwide: GLOBOCAN estimates for incidence and mortality rates in 2020. *Lancet Diabetes Endocrinol.* 2022;10(4): 264-72.
5. Chen DW, Lang BH, McLeod DA, Newbold K, Haymart MR. Thyroid cancer. *The Lancet.* 2023; 401: 1531-44.
6. Chen Q, Lin M and Wu S. Validating and Comparing C-TIRADS, K-TIRADS and ACR-TIRADS in Stratifying the Malignancy Risk of Thyroid Nodules. *Front. Endocrinol.* 2022;13:3389-95
7. Alam T, Khattak YJ, Beg M, Raouf A, Azeemuddin M, Khan AA. Diagnostic accuracy of ultrasonography in differentiating benign and malignant thyroid nodules using fine needle aspiration cytology as the reference standard. *Asian Pac J Cancer Prev.* 2014;15(22):10039–43.
8. Jiang S, Xie Q, Li N, Chen H, and Chen X. Modified models for predicting malignancy using ultrasound characters have high accuracy in thyroid nodules with small size. *Frontiers in Molecular Biosciences.* 2021; vol. 8:1-8.
9. Jasim S, Baranski TJ, Teefey SA, Middleton WD. Investigating the effect of thyroid nodule location on the risk of thyroid cancer. *Thyroid.* 2020;30(3):401-07.
10. Ramundo V, Lamartina L, Falcone R. Is thyroid nodule location associated with malignancy risk? *Ultrasonography.* 2019;38(3):231-35.
11. Singaporewalla RM, Hwee J, Lang TU, and Desai V. Clinico-pathological correlation of thyroid nodule ultrasound

- and cytology using the TIRADS and Bethesda classifications. *World Journal of Surgery*.2017;41:1807–11.
12. Li L, Chen X, Li P, Liu Y, Ma X, and Ye YQ. The value of ultrasound-guided fine-needle aspiration cytology combined with puncture feeling in the diagnosis of thyroid nodules. *Acta Cytologica*.2021;65:368–76.
  13. Maddaloni E, Briganti SI, Crescenzi A, Anguissola GB, Perrella E, Taffon C et al. Usefulness of color Doppler ultrasonography in the risk stratification of thyroid nodules. *Eur Thyroid J*.2021; 10: 339–44.
  14. Grani G, Sponziello M, Pecce V, Ramundo V and Durante C. Contemporary thyroid nodule evaluation and management. *Journal of Clinical Endocrinology and Metabolism*. 2020; 105:2869–83.
  15. Perri F, Giordano A, Pisconti S, Franco I, Maria GC, Francesco L, et al. Thyroid cancer management: from a suspicious nodule to targeted therapy. *Anti-Cancer Drugs*.2018;29:483–90.
  16. Bauer AJ. Thyroid nodules in children and adolescents. *Current Opinion in Endocrinology Diabetes and Obesity*.2019; 26:266–74.
  17. Gild ML, Chan M, Gajera J, Lurie B, Gandomkar Z and Clifton-Bligh RJ. Risk stratification of indeterminate thyroid nodules using ultrasound and machine learning algorithms. *Clinical Endocrinology*.2022;96:646–52.
  18. Li L and Qiu X. Safety and efficacy of ultrasound-guided radiofrequency ablation for benign nonfunctional thyroid nodules in children: a retrospective study of 62 patients with over four years of follow-up. *Thyroid*.2022; 32:525–35.
  19. Watanabe K, Igarashi T, Ashida H, Ogiwara S, Ohta T, Uchiyama M. Diagnostic value of ultrasonography and Tl-201/Tc-99m dual scintigraphy in differentiating between benign and malignant thyroid nodules. *Endocr*. 2019;63(2):301-9.
  20. Barr CR, Bojunga J, Cantisani V, Chammas MC, Dighe M, Vinayak S. WFUMB guidelines and recommendations on the clinical use of ultrasound elastography: Part 4 Thyroid. *Ultras Med Biol* 2017;43:4-26.
  21. Hoang JK, Middleton WD and Tessler FN. Update on ACR TIRADS: Successes, Challenges, and Future Directions, From the AJR Special Series on Radiology Reporting and Data Systems. *Am J Roentgenol*. 2021; 216(3): 570-78.
  22. Watanabe K, Igarashi T, Ashida H, Ogiwara S, Ohta T, Uchiyama M. Diagnostic value of ultrasonography and Tl-201/Tc-99m dual scintigraphy in differentiating between benign and malignant thyroid nodules. *Endocr*. 2019;63(2):301-9.
  23. Nawaz S, Khan MB, Parveen B, Asif M, Rashid M and Azeem M et al. Diagnostic Accuracy Of Thyroid Ultrasound In Detection Of Malignancy In Thyroid Nodules. *Pak J Physiol*.2018;14(3):11-13.
  24. Al-Ghanimi IA, Al-Sharydah AM, Al-Mulhim S, Faisal S, Al-Abdul wahab A and Al-Aftan A, et al. Diagnostic Accuracy of Ultrasonography in Classifying Thyroid Nodules Compared with Fine-Needle Aspiration. *Saudi J Med Med Sci*. 2020; 8(1): 25–31.