



Original Research Article

Evaluation of thyroid nodules by high resolution ultrasonography (HRUSG) and its cytological correlation in a teaching hospital

Tinaimeiru Golmei^{1*}, Kodithyala Raghavendar Babu¹

¹Dept. of Radiology, Maheshwara Medical College and Hospital, Sangareddy, Telangana, India



ARTICLE INFO

Article history:

Received 24-01-2022

Accepted 16-06-2022

Available online 13-03-2024

Keywords:

Thyroid nodules

HRUSG

Fine needle aspiration

Sensitivity

Specificity

ABSTRACT

Background: Thyroid nodules are a frequent occurrence. With the widespread use of sensitive imaging methods, a growing number of thyroid nodules are being discovered by chance. High resolution ultrasonography (HRUSG) has emerged as the most appropriate imaging modality for the assessment of thyroid nodules.

Aim of the Study: To Evaluate thyroid nodules by of high resolution ultrasonography (HRUSG) and its correlation with Fine needle aspiration cytology (FNAC).

Materials and Methods: Prospective study done in the department of radiology at Maheshwara medical college and Hospital, Chitkul, near Isnapur, Patancheru, Sangareddy, Telangana for duration of 3 years. A total of 80 cases were studied. HRUSG was done in all cases and Fine Needle Aspiration cytology was done. Radiological and pathological correlation was done and Sensitivity, specificity PPV, NPV and accuracy were calculated.

Results: Females were predominant (62.5%) when compared to males (37.5%). Among 80 thyroid nodules, colloid nodule noted in 42.5% cases, Nodular goitre in 27.5%, Hashimotos thyroiditis and follicular adenoma in 12.5% cases and Malignancy in 5% cases

Conclusion: HRUSG is a sensitive and specific imaging technique that has a high level of accuracy in the evaluation of thyroid nodules. Solid composition, hypoechogenicity, taller-than-wider form, ill-defined edges, and the presence of calcification are the most effective sonographic markers for predicting cancer.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](#), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

1. Introduction

Because of its broad availability, cheap cost, and absence of ionising radiation, ultrasonography is the imaging technique of choice for assessing thyroid nodules. Furthermore, because of its placement in the neck, the thyroid is easily accessible and susceptible to high-frequency sonographic assessment for precise characterisation.¹ Thyroid nodules are rather frequent.² Many more subclinical nodules are being found because to the widespread use of high-resolution ultrasonography. Palpation reveals them in 4% to 8% of adults, ultrasonography reveals them in 10%

to 41%, and autopsy reveals them in up to 50%.³ Sonographic parameters such as composition, echogenicity, margins, direction, presence and kind of calcifications, vascularity, and extrathyroidal extension, if present, should all be considered while evaluating a thyroid nodule. The overall sonographic pattern, in combination with the size, indicates the likelihood of malignancy and allows the radiologist to give a treatment decision.^{4,5} If there are many nodules, each one should be characterised and treatment options made based on individual nodule suspicion, which may need several FNAs.⁶ Cystic or spongiform nodules, as well as numerous nodules (without worrisome traits) in an enlarged thyroid gland, are all signs

* Corresponding author.

E-mail address: tinaimeirugolmei22@gmail.com (T. Golmei).

of benignity. Hypoechogenicity, solid composition, uneven edges, taller-than-wide orientation, and microcalcifications are all related with malignancy, with the last three having the greatest specificities.⁷ The usual procedure for determining treatment regimens for thyroid nodules is fine-needle aspiration (FNA). The "benign" category, according to the Bethesda method, the most widely acknowledged approach for reporting thyroid cytology, denotes a risk of malignancy of less than 3%.⁸ When the nodule's cytologic finding is "benign," a follow-up ultrasonography (US) is indicated.⁹ When a nodule demonstrates considerable growth or morphologic alteration with "suspicious" US characteristics on follow-up, a repeat FNA is advised.^{10,11}

2. Aim of the Study

To evaluate thyroid nodules by HRUSG and correlate its findings with fine needle aspiration cytology (FNAC).

3. Materials and Methods

Ethical institutional committee permission was taken. Written informed consent was obtained from all the cases included in the study.

This is a prospective observational research that was undertaken at the department of Radiology, Maheshwara medical college and Hospital, Chitkul, near Isnapur, Patancheru, Sangareddy, Telangana from June 2018 to May 2021.

3.1. Inclusion criteria

1. Age including 20 years to 70 years
2. Both gender.
3. HRUSG revealed a thyroid nodule in these patients.
4. Patients have thyroid nodules that seem to be malignant.

3.2. Exclusion criteria

1. Age is defined as being between 20 and 70 years old.
2. Patients having nodules and widespread thyroid enlargement.
3. Pregnant women with thyroid swelling.
4. Lactating mothers with thyroid swelling.

3.3. Methodology

After taking a properly informed written consent and complete history was taken including history of present illness, past history and personal history. Clinical examination was done and these cases were subjected to high resolution ultrasound neck. The diagnosis was confirmed by fine needle aspiration cytology (FNAC) findings.

3.3.1. Ultrasound technique

In supine posture with hyperextended neck resting on a pillow maintained under shoulder, USG Neck was done using a high-resolution ultrasonography (GE LOGIQ C5) equipped with a 5–12 MHz linear probe. The consistency, connection with the vasculature, and any other anomalies such as internal echoes, calcification, and so on were noted in transverse, longitudinal, various angled, and oblique orientations. Echogenicity, calcification, internal vascularity, cystic regions, lymphadenopathy, and background thyroid alterations were all considered while evaluating the nodules. The nodules were classed as hypoechoic when their echogenicity was lower than that of the thyroid gland, and hyperechoic when their echogenicity was higher than that of the background thyroid parenchyma. Microcalcification (for little calcification without shadowing and measuring less than 1mm) and macrocalcification (for larger calcification measuring more than 1mm) were used to classify the calcification (calcification with shadowing measuring more than 1mm, including coarse and curvilinear calcification). Internal vascularity was seen on Doppler, as well as cystic regions. When nodes were enlarged by more than 1 cm in their short axis or had microcalcification or cystic regions (regardless of size) and architectural distortion, lymphadenopathy was identified. The remainder of the thyroid's architecture was examined for adenomatous hyperplasia, colloid nodules, and Hashimoto's thyroiditis. When possible, the final ultrasonography diagnosis based on these features was compared to FNAC and histologic evaluation of the post-thyroidectomy samples.

FNAC was done on the cases presented with thyroid nodules. It was done with 10 cc disposable syringe under all aseptic measures. Aspirated material was stained with H & E and Pap stain and reported by senior pathologist in Pathology department.

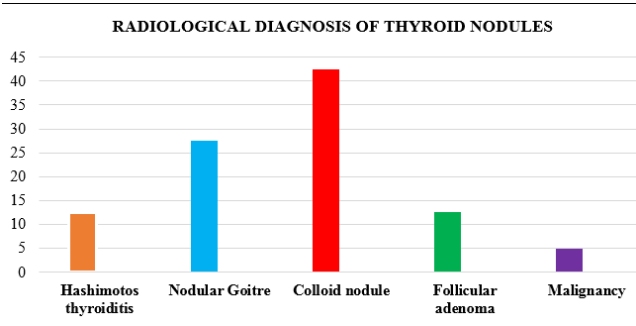
3.4. Statistical analysis

Data will be entered in Microsoft Excel sheet and will be analysed using SPSS version 20.0 statistical software. Data will be depicted in the form of tables and graphs. Sensitivity, Specificity, Accuracy, Negative predictive value, Positive predictive value were calculated from the data.

4. Results & Observations

Age distribution varied from 20 years to 70 years. Majority of the cases were present between 41-50 years ie, 48.5% (39/80), 27.5% (22/80) constituted in 31-40 years, 12.5% (10/80) occupied among 20-30 years and 8.7% (07/80) among 51-60 years. Least was noted among 61-70 years (2.5%). The youngest being 21 years old and the eldest, 69 years old. The mean age was 42 years.

On gender distribution females were predominantly (62.5%) presented with thyroid nodules when compared to males (37.5%).



Graph 1: Bar diagram showing radiological diagnosis of thyroid nodules

In our study among 80 thyroid Nodules, Colloid Nodule noted in 42.5% cases (34/80), Nodular goitre in 27.5% (22/80), Hashimoto's thyroiditis and follicular adenoma constituted 12.5% (10/80) each and malignancy was reported in 5% (04/80) cases.

Accordingly, we evaluated the following parameters in thyroid masses: size and location of the lesion, number of nodules, echogenicity, internal consistency, calcification, haemorrhage, necrosis, thyroid capsule invasion, vascular invasion, trachea and oesophageal involvement, mediastinal extension, and adenopathy.

In our study Solitary nodules constituted 58.5% (47/80) and multiple nodules constituted 41.2% (33/80). Based on echogenicity, the nodules in our investigation varied in size from 5mm to 5 cms. 82.5% (66/80) nodules were hypoechoic, 17.5% (14/80) nodules were hyper echoic. All the benign thyroid nodules showed well defined margins in 92.5% cases (74/80) and 7.5% (06/80) of malignant thyroid nodules showed ill defined margins. Central vascularity was present in 17.5% (14/80) cases and no significant central vascularity was seen in 82.5% (66/80) cases. Calcification was seen in 2.5% (02/80) cases. Microcalcification or macrocalcification were seen in these calcifications. In our dataset, microcalcifications were only found in papillary carcinomas and only in 02/04 malignant patients. Macrocalcification was seen in 01/04 malignant cases. No calcification was observed in 97.5% (78/80) cases. Both Solid and cystic areas were identified in 7.5% (06/80) cases.

In our study 42.5 % (34/80) reported as colloid nodule and 21.5%(17/80) as nodular goitre. Follicular adenoma IN 10% (08/80) and Malignancy in 7.5% (06/80) cases.

4.1. Statistical analysis

Statistical analysis was done to find out the value of HRUSG in detecting thyroid nodules.

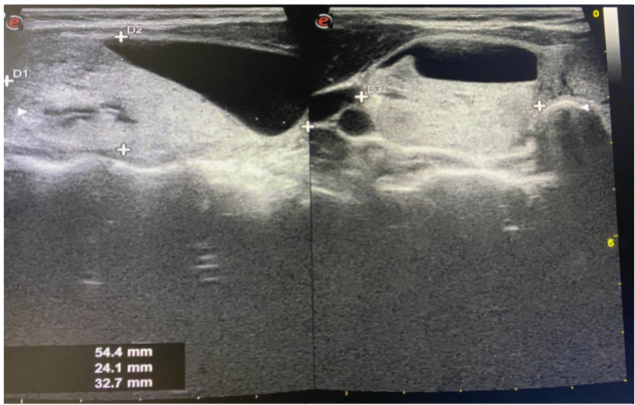


Figure 1: A well-defined hyperechoic nodule with cystic component.

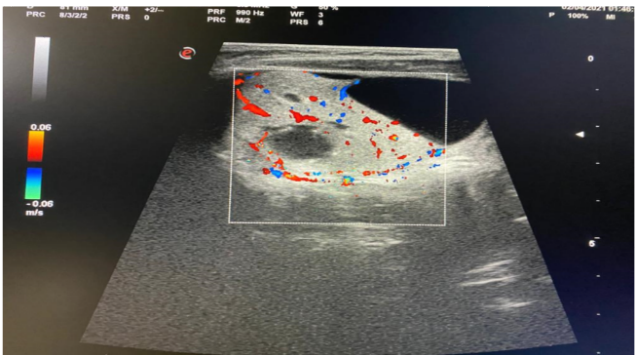
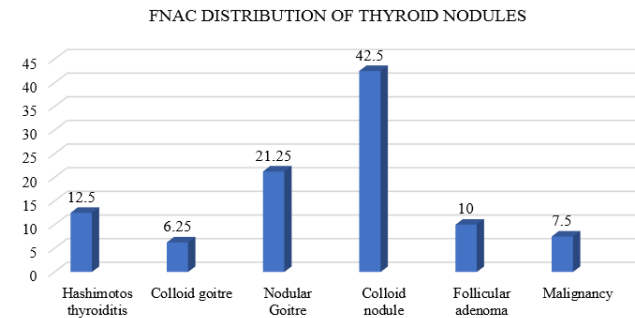


Figure 2: On colour doppler showing increased vascularity.



Graph 2: Bar diagram showing FNAC distribution of thyroid nodules

Sensitivity = TP = 66.6%
TP+FN
Specificity = TN = 100%
TN+FP
PPV = TP = 100%
TP+FP
NPV = TN = 97.3%
TN+FN
Accuracy = TP+TN = 97.5%

Table 1: USG findings of thyroid nodules

S.No.	USG findings of thyroid lesions	Benign (n-76)	Malignant (n-04)	Total (n=80)
1	Number of nodules			
	• Single	44 (55 %)	03(3.7 %)	47(58.7 %)
	• Multiple	32(40 %)	01(1.2 %)	33(41.2%)
2	Internal consistency			
	• Solid	71(88.7 %)	03(3.7 %)	74(92.5%)
	• Cystic	-	-	
	• Solid and cystic	05(6.2 %)	01(1.2 %)	06(7.5 %)
3	Echogenecity			
	• Hypoechoiec	66(82.5 %)	-	66(82.5%)
	• Hyperechoiec	10(12.5 %)	04(5%)	14(17.5%)
	• Isoechoiec	-	-	-
4	Margins			
	• Well defined	74(92.5 %)	-	74(92.5%)
	• ill defined	02(2.5%)	04(5 %)	06(7.5 %)
5	Calcification			
	• Present	-	02(2.5 %)	02(2.5%)
	• Absent	76(95 %)	02(2.5 %)	78(97.5 %)
6	Peripheral sonolucent halo			
	• Present	10(12.5%)	-	10(12.5%)
	• Absent	66(82.5 %)	04(5 %)	70(87.5 %)
7	Internal vascularity			
	• Present	10(12.5 %)	04(5 %)	14(17.5 %)
	• Absent	66(82.5 %)	-	66(82.5 %)

Table 2: USGand FNAC Findings correlation

USG diagnosis	FNAC diagnosis	Remarks
Hashimotos thyroiditis(10)	Hashimotos thyroiditis (10)	True negative (TN)
	Nodular Goitre (15)	True negative(TN)
Nodular Goitre (22)	Colloid goitre (05)	True negative(TN)
	Follicular adenoma(02)	True negative(TN)
Colloid nodule (34)	Colloid nodule (34)	True negative(TN)
	Follicular adenoma(08)	True negative(TN)
Follicular adenoma(10)	Follicular carcinoma (02)	False negative(FN)
	PTC (02)	True positive(TP)
Malignancy(04)	Follicular Carcinoma (01)	True positive(TP)
	Anaplastic carcinoma (01)	True positive(TP)

TP+TN+FN

To summarise the findings, the false negative rate was 10.2%. The sensitivity and specificity were respectively 66.6 percent and 100 percent. The negative predictive value was 97.3 percent, while the positive predictive value was 100%. HRUSG has 97.5 percent accuracy in distinguishing benign from malignant thyroid nodules.

5. Discussion

In our study majority (48.5%) of the cases were present between 41-50 years. Least was noted among 61-70 years. The mean age was 42 years. In Baby Manoj PP et al study¹² the majority of the patients (52%) were between the ages of 40 and 49. The mean age was 39 years.

Females were predominantly (62.5%) presented with thyroid nodules when compared to males (37.5%) in our

study. Similar findings were observed by various studies. Such as in study conducted by Anuradha Kapali et al¹³ 10 were males and 47 were females. In Chinta Vittal Prasad et al study¹⁴ 89 were female and 11 were male. In Gururaj Sharma et al study¹⁵ there were 118 females and 20 males .In Baby Manoj PP et al study¹² there were 22 (88%) females and 3 males (12%). Hence our findings were correlating with respective studies.

Our study observed 75 benign thyroid nodules and 04 malignant nodules out of 80 thyroid nodules. Our study findings were collaborating with Gururaj Sharma et al study¹⁵ where he also observed 124 benign thyroid nodules and 14 malignant nodules.

5.1. Comparative studies related to USG distribution

In our study Solitary nodules constituted 58.5% (47/80) and multiple nodules constituted 41.2% (33/80). The nodules in our research varied in size from 5mm to 5 cm. Based on echogenicity 82.5% (66/80) nodules were hypoechoic, 17.5% (14/80) nodules were hyper echoic. All the benign thyroid nodules showed well defined margins in 92.5% cases (74/80) and 7.5% (06/80) of malignant thyroid nodules showed ill defined margins. Central vascularity was present in 17.5% (14/80) cases and no significant central vascularity was seen in 82.5% (66/80) cases. Calcification was seen in 2.5% (02/80) cases. Microcalcification or macrocalcification were seen in these calcifications. In our dataset, microcalcifications were only found in papillary carcinomas and only in 02/04 malignant patients. Macrocalcification was seen in 01/04 malignant cases. No calcification was observed in 97.5% (78/80) cases. Both Solid and cystic areas were identified in 7.5% (06/80) cases.

In a study conducted by Anuradha Kapali et al¹³ Hypoechoic nodules accounted for 51% of the total, whereas hyperechoic nodules accounted for 49% of the whole. In 68.4 percent (39) of the patients, central vascularity was found, whereas 31.5 percent (18) of the patients had no substantial central vascularity. There was no calcification in 54.3 percent (31) of the patients, macro calcification in 26.3 percent (15) of the patients, micro calcification in 17.5 percent (10) of the patients, and one patient had both macro and micro calcification (1.7 percent). In 23 percent of the patients, cystic regions were found, two patients had honeycombing, and 56.1 percent (32) of the patients had no cystic areas.

In Baby Manoj PP et al study¹² by According to HRUSG, 40% of lesions were hypoechoic, 32% were mixed echogenic, and 8% were hyperechoic. In 28% of instances, there was a perilesional halo, and in 20% of cases, there was calcification. In 20% of instances, a single nodule is found, whereas in the other 80%, several nodules are seen. In 52 percent of cases, the boundary was clearly defined, whereas in 48 percent, it was not. Sixty-eight percent of the lesions were solid, whereas 32 percent were solidcystic. In a study done by Gururaj Sharma et al study.¹⁵ On USG, all of the nodules in their series that were identified as malignant were solid or mainly solid lesions. The majority of malignant nodules (12/14) had hypoechoic internal echo texture, while the majority of benign nodules (89/124) had either hyperechoic or anechoic internal echo texture (cystic). The majority of malignant nodules (10/14) had poorly defined borders, which were either vague or irregular in form, while the majority of benign nodules (102/124) had a smooth, well-defined contour. Calcifications were seen in 11 of 14 cancerous nodules and 28 of 124 benign nodules. Microcalcifications were found only in papillary carcinomas in our study, with

8/9 patients having microcalcifications. 5/14 cancers and 28/124 benign nodules had macrocalcification. The majority of malignant lesions (12/14) had internal vascularity inside the nodule, while benign nodules were avascular or had a perinodular vascular pattern.

5.2. Comparative studies related to statistics

The false negative rate in our research was 10.2 percent. The sensitivity and specificity were respectively 66.6 percent and 100 percent. The negative predictive value was 97.3 percent, while the positive predictive value was 100%. HRUSG has 97.5 percent accuracy in distinguishing benign from malignant thyroid nodules. In contrast, according to a research done by Baby Manoj PP et al¹², ultrasonography has a sensitivity of 80%, specificity of 75%, positive predictive value of 44%, negative predictive value of 93%, and accuracy of 76%. Sensitivity, specificity, positive predictive value, and negative predictive value of 72 percent, 88 percent, 67 percent, and 90 percent, respectively, were reported in the Chinta Vittal Prasad et al¹⁴ research.

6. Conclusion

HRUSG is a sensitive and specific imaging modality for evaluating thyroid nodules, and it has a high degree of accuracy in distinguishing benign from malignant thyroid nodules. The false negative rate in our research was 10.2 percent. The sensitivity and specificity were respectively 66.6 percent and 100 percent. The negative predictive value was 97.3 percent, while the positive predictive value was 100%. 97.5 percent accuracy was achieved.

7. Source of Funding

None.

8. Conflict of Interest

None.

References

1. Danese D, Sciacchitano S, Farsetti A. Diagnostic accuracy of conventional versus sonography-guided fine-needle aspiration biopsy of thyroid nodules. *Thyroid*. 1998;8(1):15–21.
2. Solbiati L, Charboneau JW, Osti V, James EM, Hay ID. The thyroid gland. In: Rumack C, Wilson S, Charboneau J, editors. *Diagnostic Ultrasound 3rd edn.* vol. 1. St. Louis, Missouri: Elsevier Mosby; 2005. p. 735–70.
3. Frates MC, Benson CB, Charboneau JW, Cibas ES, Clark OH, Coleman BG, et al. Management of thyroid nodules detected at US: Society of Radiologists in Ultrasound consensus conference statement. *Radiology*. 2005;237(3):794–800.
4. Brito JP, Gionfriddo MR, Al-Nofal A, Boehmer KR, Leppin AL, Reading C, et al. The accuracy of thyroid nodule ultrasound to predict thyroid cancer: systematic review and meta-analysis. *J Clin Endocrinol Metab*. 2014;99(4):1253–63.
5. Smith-Bindman R, Lebda P, Feldstein VA, Sellami D, Goldstein RB, Brasic N, et al. Risk of thyroid cancer based on thyroid ultrasound

- imaging characteristics: results of a population-based study. *JAMA Intern Med.* 2013;173(19):1788–96.
6. Haugen BR, Alexander EK, Bible KC, Doherty GM, Mandel SJ, Nikiforo YE, et al. American Thyroid Association Management Guidelines for Adult Patients with Thyroid Nodules and Differentiated Thyroid Cancer: The American Thyroid Association Guidelines Task Force on Thyroid Nodules and Differentiated Thyroid Cancer. *Thyroid.* 2015;26(1):1–133.
 7. Kim JY, Lee CH, Kim SY, Jeon WK, Kang JH, An SK, et al. Radiologic and pathologic findings of nonpalpable thyroid carcinomas detected by ultrasonography in a medical screening center. *J Ultrasound Med.* 2008;27(2):215–23.
 8. Cibas ES, Ali SZ. The Bethesda system for reporting thyroid cytopathology. *Thyroid.* 2009;19(11):1159–65.
 9. Layfield LJ, Abrams J, Cochand-Priollet B, Evans D, Gharib H, Greenspan F, et al. Post-thyroid FNA testing and treatment options: a synopsis of the National Cancer Institute Thyroid Fine Needle Aspiration State of the Science Conference. *Diagn Cytopathol.* 2008;36(6):442–8.
 10. Cooper DS, Doherty GM, Haugen BR, Kloos RT, Lee SL, Mandel SJ, et al. Revised American thyroid association management guidelines for patients with thyroid nodules and differentiated thyroid cancer. *Thyroid.* 2009;19(11):1167–214.
 11. Gharib H, Papini E, Paschke R, Duick DS, Valcavi R, Hegedüs L, et al. American Association of Clinical Endocrinologists, Associazione Medici Endocrinologi, and European Thyroid Association Medical guidelines for clinical practice for the diagnosis and management of thyroid nodules: executive summary of recommendations. *J Endocrinol Invest.* 2010;33(5):51–6.
 12. Manoj PB, Innisai A, Hameed DS, Khader A, Gopanraj M, Ihare NH, et al. Nikhil H Ihare Original Research Article Correlation of high-resolution ultrasonography findings of thyroid nodules with ultrasound-guided fine-needle aspiration cytology in detecting malignant nodules: A retrospective study in Malabar region of Kerala, South India. *J Family Med Prim Care.* 2019;8(5):1613–6.
 13. Kapali A, Jaipal B, Raghuram P, Bangar R, Atmakuri SK. Role of Ultrasonography in Thyroid Nodules with Pathological Correlation. *Int J Contemp Med Res.* 2016;3(5):2393–915.
 14. Prasad CV. Evaluation of correlation between ultrasonography and FNAC of thyroid nodules. *IAIM.* 2016;3(2):92–7.
 15. Sharma G, Keshava GH, Hanchinal V. Veeresh Hanchinal Original Research Article Ultrasonographic Evaluation of Thyroid Nodules with Pathologic Correlation. *Int J Anat.* 2017;6(2):53–7.

Author biography

Tinaimeiru Golmei, Assistant Professor

Kodithyala Raghavendar Babu, Assistant Professor

Cite this article: Golmei T, Babu KR. Evaluation of thyroid nodules by high resolution ultrasonography (HRUSG) and its cytological correlation in a teaching hospital. *Panacea J Med Sci* 2024;14(1):92-97.