Assessment Of Diagnostic Accuracy Of High Resolution Ultrasonography, Compared To Cytopathological Findings In Evaluation Of Various Thyroid Lesions In A Tertiary Care Hospital Of North East,India

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Abstract

Background:

Thyroid gland is a single midline endocrine organ situated in the anterior part of neck in our body with the primary function of synthesizing hormones that play a vital role in the regulation of metabolic functions. Triiodothyronine (T3) and Thyroxine (T4) are two hormones synthesized within the thyroid and are released from this gland in response to a feedback mechanism with the pituitary-hypothalamic axis. The spectrum of symptoms of diseases involving thyroid gland are varied and the clinical manifestations are due to increased or decreased function of the thyroid gland. Nodular thyroid diseases are relatively common and found in 3-7% of the population worldwide. Because of the superficial location of thyroid gland, it allows excellent visualization and evaluation of normal anatomy and pathologic conditions by high resolution real time gray scale ultrasonography.

Material And Methods:

A cross sectional study was conducted in Department of Radiodiagnosis, AGMC & GBP hospital, Agartala, Tripura; for a period of one year from January 2023 to December 2023. The study included fifty two(52) patients having various thyroid lesions sent from ENT outpatient department for ultrasound evaluation of the lesions along with ultrasound guided FNAC for cytopathological correlation.

Results:

Out of these 52 patients 3 were male and 49 were female. The most commonly affected age group was 31-40 years (36.53%) followed by 41-50 years (30.73%). Among the thyroid lesions, 8 cases (15.38%) were suspicious of malignancy and 44 cases (84.61%) were found to be benign in nature on gray scale high resolution ultrasound. Among the benign lesions multinodular goiter with thyroiditis were 32.69%, colloid goiter were 26.32%, thyroiditis were 11.53%, adenomatous nodule were 9.61%, and thyroid cyst were 3.84% seen on ultrasound finding diagnosis. On correlation with FNAC, the sensitivity of diagnosed benign lesions was 95.65%, specificity was 83.33%, PPV was 97.77%, NPV was 71.42% and in case of malignant lesions the sensitivity was 85.71%, specificity was 95.55%, PPV was 75.0% and NPV was 97.72%.The diagnostic accuracy of high resolution ultrasound was found to be 94.23%.

Conclusion:

High resolution ultrasonography is a safe, less time consuming, radiation free, easy to perform, repeatable modality for evaluation of thyroid lesions. It is the best non invasive tool for assessing the morphology of the gland as well as helps in diagnosing various thyroid lesions and differentiating them into benign and malignant. USG followed by FNAC increases the accuracy to diagnose various thyroid lesions so by which unnecessary thyroid gland surgery can be avoided. Therefore, ultrasonography of thyroid should be considered as a first step and an investigation of choice for evaluation of various thyroid lesions.

Key Words: Thyroid lesions, USG (Ultrasonography), FNAC (Fine needle Aspiration Cytology),

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I. Introduction

Thyroid gland is the largest endocrine gland in the body and the first to develop in the fetal life. It has two elongated lateral lobes (right and left), and is connected by the isthmus. Approximately 40% of individuals have a pyramidal lobe arising from the isthmus that extends towards the hyoid bone.[1] Because of its superficial location in neck it allows excellent visualization as well as evaluation of normal anatomy and pathologic condition by high resolution real-time grey scale sonography.[2] Thyroid nodules are a common disorder, with a prevalence of 2–6% through palpation and 19–35% through ultrasound inspection in the general population.[3] The primary aim of thyroid nodule evaluation is to determine whether the nodule is malignant or benign and whether it will or will not require surgery[4]. High-definition ultrasonography is usually recommended for clinically detected nodules in euthyroid individuals. Horvath et al. proposed a thyroid imaging recording and data system (TIRADS) to assess the risk of malignancy in thyroid nodules[5]. As it is not feasible from an economic and patient anxiety point of view to do FNAC from every thyroid nodule in order to exclude malignancy, a reliable guideline was necessary to specifically target nodules that require FNAC. The British Thyroid Association (BTA) recently produced a US classification (U1–U5) of thyroid nodules to facilitate the decision making process regarding the need to perform Fine needle aspiration cytology (FNAC) in suspicious/ unequivocal cases[6]. Ultrasound (US), being a non-invasive radiological technique should be done in all patients with a thyroid disease to differentiate malignant from benign nodules. Having a single nodule, irregular edges, and micro calcification increase the chance of malignancy 3.6, 5.4, and 39 times, respectively[7]. The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) determines the patient's eligibility for surgical or medical treatment. Using ultrasound-guided FNA allows proper localization of the thyroid nodule during aspiration. With both benign and malignant thyroid nodules becoming more prevalent, it is crucial to organize thyroid cancer prevention strategies[8]. This study aims to identify associations of USG characteristics of different thyroid nodules to differentiate between malignant & benign nodule and to find out the diagnostic accuracy of High resolution ultrasound as compared to FNAC.

II. Materials & Methods

A cross sectional study was conducted in Department of Radiodiagnosis, AGMC & GBP hospital, Agartala, Tripura; for a period of one year from January 2023 to December 2023. The study included fifty two (52) patients having various thyroid lesions sent from ENT outpatient department for ultrasound evaluation of the lesions along with ultrasound guided FNAC for cytopathological correlation.

Sample size of the study: The study included fifty two (52) patients having various thyroid lesions.

Inclusion criteria:
1. Adult patients of age 18 years or above with clinically symptomatic and suspected case of having thyroid lesions or disorders.
2. Patients who have given the consent.

Exclusion criteria:
1. Patient with bleeding diathesis
2. Patient who had prior surgery/ radiotherapy of the thyroid gland
3. Patients who have not given consent for FNAC

Aim And Objective:
I. To determine the diagnostic accuracy of high resolution ultrasonography & its correlation with cytopathological findings in evaluation of various thyroid lesions.
II. To determine the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of high resolution ultrasound imaging in diagnosis of thyroid lesions by comparing against cytopathological findings.

52 cases were included in our study. All the patients were sent from the ENT Outpatient Department for ultrasonography of neck with USG guided FNAC if indicated. All patients included in our study underwent general physical examination & local examination of neck. The following tests were performed: serum Thyroid Stimulating Hormone (TSH), free Triiodothyronine (FT3), free Thyroxine (FT4), Hemoglobin, RBS etc.

Thyroid ultrasonography-
Thyroid ultrasound examination was done, using a 7.5- MHZ transducer (Siemens scanner) including brightness B-mode, color-coded Doppler imaging, and transverse and longitudinal scanning of the thyroid gland

for all cases. We used different ultrasound characteristics of thyroid nodules to characterize them as benign or malignant nodule.

Ultrasound Image analysis-
In our study we used TIRADS scoring system to characterize the nodular lesions of thyroid. TIRADS scoring is usually determined from five distinct items of ultrasound findings. The cumulative score is proportional to the TR (TIRADS) category and malignancy rate.

One score is assigned from each of the following categories:
• Composition
- Cystic or completely cystic: 0 points
- Spongiform : 0 points
- Mixed cystic and solid: 1 point
- Solid or almost completely solid: 2 points

• Echogenicity
– Anechoic: 0 points
– Hyper- or isoechoic: 1 point
– Hypoechoic: 2 points
– Very hypoechoic: 3 points

• Shape: (assessed on the transverse plane)
– Wider than tall: 0 points
– Taller than wide: 3 points

• Margin
– Smooth: 0 points
– Ill-defined: 0 points
– Lobulated/irregular: 2 points
– Extra thyroidal extension: 3 points

• Echogenic foci: (choose one or more)
– None: 0 points
– Large comet tail artifact: 0 points
– Macro-calcifications: 1 point
– Peripheral/rim calcifications: 2 points
– Punctate echogenic foci: 3 points

Scoring & Classification

| TR1	TR2	TR3	TR4	TR5
0 points	2 points	3 points	4-6 points	>/= 7 points
Benign	Not suspicious	Mildly suspicious	Moderately suspicious	Highly suspicious

Ultrasound (U/S) guided FNAC of thyroid nodules-
Before starting the procedure every patient was clearly explained regarding the procedure & informed consent was taken. Patients were asked to lie down with head extended. Then we used ultrasound scanner to localize the nodule for FNAC. A 21-G needle (usually) connected to a plastic syringe was used during the procedure, which was carried out under strictly aseptic settings. At least two distinct passes were made to sample the aimed nodule. Smears were made and fixed by 70% ethyl alcohol spray and then were transported in slide containers to Cytopathology Unit, Pathology Department.
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Statistical analysis: Statistical analysis was done using the Statistical Package for Social Sciences, version 25 (SPSS Chicago IL, USA). Continuous measurements were summarised in mean and standard deviation while categorical data was documented using frequency and percentages. Sensitivity, specificity, positive and negative predictive values were calculated to determine the diagnostic accuracy using 2-by-2 contingency tables.

III. Observation & Results:

In our study, we analyzed 52 patients with thyroid lesions. The age range was between 18 to 75 years (Fig 1a). Females represent the majority of cases (*n* = 49, 94.2%). Most of the patients were between 31-40 years of age (36.53%) (Fig1b). Among the 52 patients who underwent USG in our study, 35 patients (67.30%) had heterogeneous thyroid echo texture and 17 patients (32.69%) had homogenous thyroid echo texture. Among the 52 patients 43 patients (82.69%) had definitive thyroid nodule on ultrasound. Among the 52 patients 32 patients (74.41%) had multiple thyroid nodules on ultrasound whereas 11 patients (25.58 %) had single thyroid nodule on ultrasound.
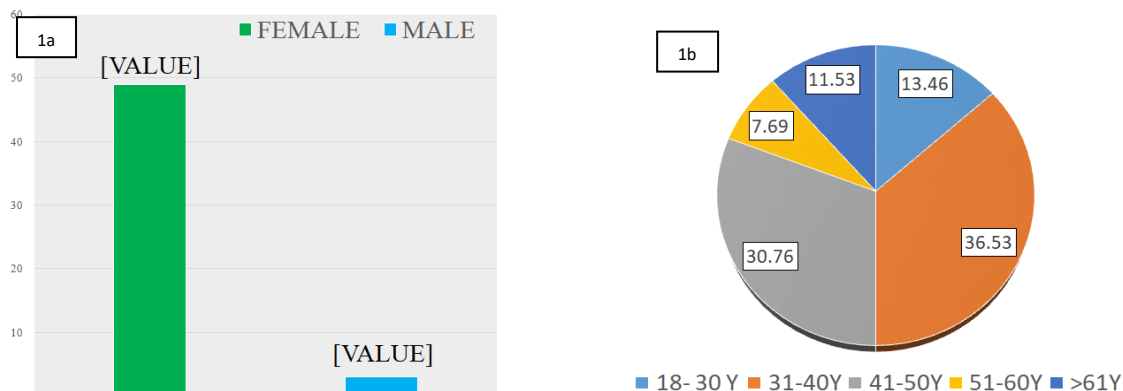
Fig 1a. Distribution of patients based on Gender
**Fig 1b. Distribution of patients based on age groups**

Table 1 shows the ultrasonography features of various nodular lesions of thyroid encountered in our study.

Table1. Nodules characteristics on Ultrasonography

Composition	
- Cystic or completely cystic	n= 16 (37.20 %)
- Spongiform	n= 03 (11.62%)
- Mixed cystic and solid	n= 02 (04.65%)
- Solid or almost completely solid	n= 22 (42.30 %)
Shape: (assessed on the transverse plane)	
– Wider than tall	n= 36 (83.72%)
– Taller than wide	n= 07 (16.27%)
Margin	
– Smooth	n= 35 (81.39%)
– Ill-defined	n= 06 (13.95%)
– Lobulated/irregular	n= 02 (04.65%)
– Extra thyroidal extension	n= 00 (00.00%)
Echogenicity	
– Anechoic	n= 06 (13.95%)
– Hyper- or isoechoic	n= 18 (41.86%)
– Hypoechoic	n= 12 (27.90%)
– Very hypoechoic	n= 07 (16.27%)
Echogenic foci:	
– None	n= 29(67.44%)
– Large comet tail artifact	n= 02(04.65%)
– Macro-calcifications	n= 05(11.62%)
– Peripheral/rim calcifications	n= 07(16.27%)
– Punctate echogenic foci	n= 00(00.00%)
TIRADS	
– TI-RADS 2	n= 14(32.55%)
– TI-RADS 3	n= 05(11.62%)
– TI-RADS 4	n= 16(37.20%)
– TI-RADS 5	n= 08(18.60%)

**Table 2: Distribution of Thyroid lesions based on ultrasound features**

USG Diagnosis	Number	Percentage
Thyroiditis	06	11.53%
Colloid goitre	14	26.92%
Adenomatoid Nodule	05	09.61%
Multinodular goitre with thyroiditis	17	32.69%
Thyroid Cyst	02	03.84%
Suspicious/Possible Malignancy	08	15.38%
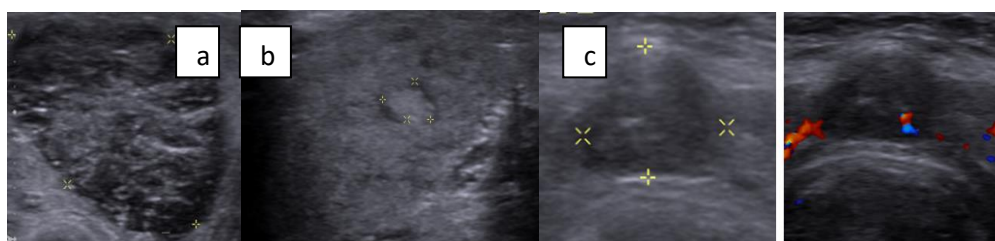
Fig 2. USG Characteristics of different thyroid nodules (Gray scale & Doppler examination).
2. a. – **Axial image shows spongiform nodule in left lobe of thyroid as honeycomb or puff pastry appearance (TI-RADS 2)**
2. b- Axial image shows follicular adenoma in right lobe of thyroid as well defined relatively hyper echoic nodular lesion with peripheral hypoechoic halo(TI-RADS 4)
2. c- Axial image shows well defined hypoechoic nodular lesion (taller than wider) in isthmus of thyroid with internal areas of calcification & vascularity (TI-RADS 5)- Papillary carcinoma thyroid.

In cytopathological analysis 88.25% patients had benign thyroid lesions, whereas 11.75% lesions were found to be malignant. Among malignant lesions, most common was papillary thyroid carcinoma(7.69%) (Fig. no.3a) followed by medullay thyroid carcinoma(1.92 %) (Fig. no.3b)
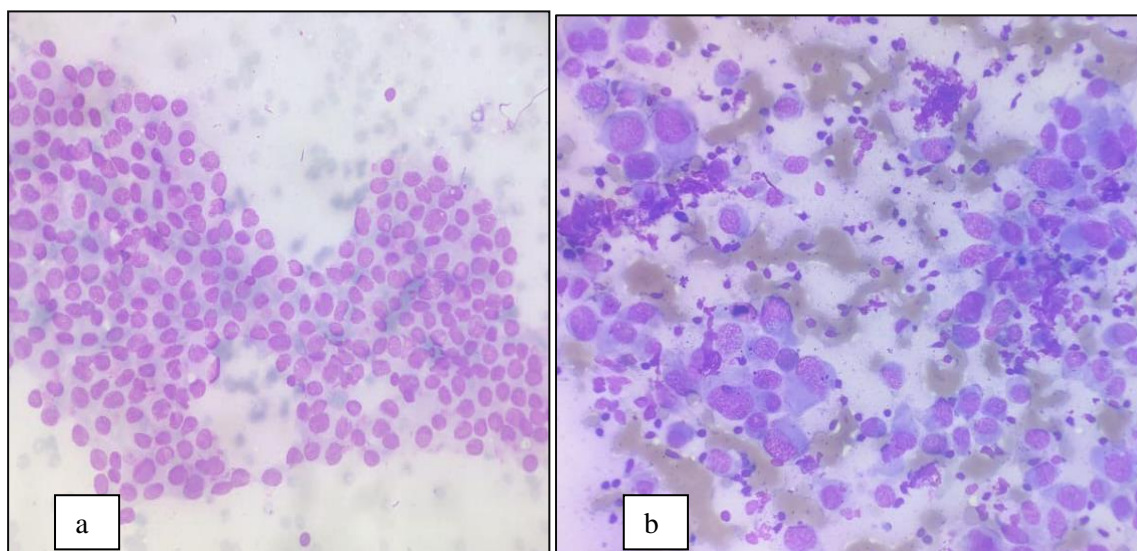
Fig. 3a: Papillary Carcinoma. Enlarged epithelial cells arranged in monolayered sheet, 'anatomical' edge is noted at the upper row. Cells show oval nuclei, powdery chromatin. Intranuclear cytoplasmic inclusions are also seen.
Fig.3b: Medullary Carcinoma. Predominanly dispersed cells showing anisonucleosis, oval to plasmacytoid cells, enlarged nuclei, 'salt and pepper' chromatin and basophilic cytoplasm. Binucleation is also seen.

Table 3: Comparison of Ultrasound diagnosis with FNAC diagnosis:

	Sensitivity	Specificity	PPV	NPV
Thyroiditis	85.71	97.77	85.71	97.77
Colloid goiter	100	97.43	92.85	100
Adenomatous nodule	100	97.91	80	100

Multinodular goiter with thyroiditis	85.00	96.87	94.44	91.17
Thyroid cyst	100	100	100	100
Malignancy	85.71	95.55	75.00	97.72

By comparing with the final cytopathological results, the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of Thyroid ultrasonography (TI-RADS) for predicting thyroid malignancy were 88%, 92%, 81%, and 76.6% respectively; whereas the sensitivity, specificity, PPV and NPV of FNAC in diagnosing Thyroid malignancy were 77.8%, 98%, 90% and 88.2% respectively (Table 2)

IV. Discussion

There is approximately 4-5% incidence of clinically apparent thyroid lesions in general population.[9]A thyroid nodule is defined as a discrete lesion within the thyroid gland that is distinguishable from the adjacent parenchyma at USG. Noticeable increase in thyroid carcinoma incidence has been observed due to the wide use of neck ultrasonography and the surveillance of USG-guided FNAC of thyroid nodules.[10] Detailed clinical history & examination, lab parameters mainly thyroid-function tests, High frequency thyroid ultrasonography describing the different types of nodules based TI-RADS features and US-guided FNAC are the key parameters for proper evaluation of thyroid nodules.[11] Single ultrasonography feature cannot differentiate between benign & malignant nodule so in our study we used different USG characteristics(Echogenicity, shape, calcification, vascularity, peripheral halo etc.) to label thyroid nodule as benign or malignant.[12] Our study is a cross sectional observational study which was conducted in the Department of Radiodiagnosis, AGMC & GBP Hospital in one year period among 52 patients. Among the 52 patients majority were female patients (n=49; 94.2%). It is due to fact that thyroid disorder is female prone owing to the presence of estrogen receptors in the thyroid tissue.[13] Among the 52 cases included in our study most commonly affected age group was 31-40years (36.53%), followed by 41-50 years (30.73%). Similar finding was found in the previous study conducted by Sudhir V. Bhise et al.[14] On the basis of the ultrasonography features most of the thyroid nodules are non-neoplastic. Based on the ultrasonography feature 44 cases (84.61%) were benign in nature & 8 cases (15.38%) were suspicious of malignancy in our study which is correlating with the studies conducted by Chaudhary et al, Shukla S et al.[15] Among the benign lesions found in our study most common was multinodular goitre with thyroiditis(n=17,32.69%) followed by colloid goitre(n=14;26.92%).In a previous study by Bumiya and Roopa , benign pathology was observed in 90% cases, amongst which the commonest was multinodular goitre (66%) patients.[16] Papillary carcinoma was the most diagnosed malignancy among examined nodules in our study which is correlating with the study done in past conducted by. In our study, ultrasound has sensitivity, specificity, positive predictive value, negative predictive value of 88%, 92%, 81%, and 76.6% respectively. In a study by Popli *et al.*, the sensitivity was 81.8% and specificity was 87.2%.In another study done by Manoj, *et al* sensitivity, specificity , positive predictive value, negative predictive value was found 80%, 75%, 44%, & 93% respectively.[17,18] From our results we recommend USG should be first step in diagnosis of suspected thyroid nodule.

V. Conclusion

High resolution duplex ultrasound is an excellent modality to study the anatomy of thyroid gland because of its superficial location in neck. High resolution duplex ultrasound is less expensive, easily available, less time consuming. Because of its high resolution it can detect palpable as well as non palpable thyroid nodule & characterize it as benign & malignant. FNAC followed by USG increases the detection rate of malignant nodules of thyroid. Ultimately High Resolution USG is better non invasive tool for diagnosis of various thyroid swellings and can also differentiate between benign and malignant lesion

Conflicts of interest
There are no conflicts of interest.

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