

HIGH-FREQUENCY SONOGRAPHIC EVALUATION OF THYROID LESIONS

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Abstract

Background: Thyroid diseases are the most common among all the endocrine diseases in India. Since the thyroid gland is superficially located, high-resolution real-time gray scale sonography can demonstrate normal thyroid anatomy and pathologic conditions. To evaluate the role of ultrasound as the primary diagnostic imaging modality in thyroid disease. **Materials and Methods:** Patients suspected of having thyroid swelling were included in the study. Ultrasonography (USG) was done as initial diagnostic imaging for thyroid lesions and evaluated accordingly. These thyroid lesions were subjected to ultrasound-guided FNAC to confirm the diagnosis. Later the validity of the ultrasound diagnosis of FNAC diagnosis was analysed. **Result:** Ultrasonography showed relatively high sensitivity and specificity for diagnosing and characterising thyroid lesions such as thyroid adenomas, colloid cysts and multinodular goitre. The sensitivity of ultrasound was 98.55%, and specificity in our study was 100%. USG could considerably differentiate malignant and non-malignant thyroid lesions. USG showed a relatively high diagnostic rate. USG-guided FNAC was a safe procedure for the detection of thyroid diseases. **Conclusion:** The study concluded that USG can be used as a primary imaging modality with high sensitivity and specificity to diagnose and characterise thyroid diseases. USG helps in guiding FNAC for confirmation of diagnosis.

INTRODUCTION

Thyroid swelling, commonly caused by diffuse thyroid gland enlargement (diffuse colloid goitre), is a prevalent concern in outpatient departments. Enlarged thyroid masses or nodules often manifest as primary symptoms of thyroid neoplasms, while thyroid enlargement can be associated with thyroid autoimmune diseases like hypothyroidism and hyperthyroidism. However, clinical assessment alone may not provide definitive results, necessitating additional diagnostic methods such as ultrasonography, fine needle aspiration cytology (FNAC), and histopathological examination (HPE) for precise diagnosis.^[1-3]

Advancements in high-resolution B-mode ultrasound have improved ultrasonography's diagnostic capabilities. A 5-8 MHz sector probe is used for deep structure assessment, while a higher frequency (7-12 MHz) linear probe visualizes surface features. Color Doppler ultrasonography is valuable in evaluating vascular lesions and enlarged lymph nodes and assessing thyroid tissue vascularity.^[4-6]

Color Doppler ultrasonography, a non-invasive technique, provides essential insights into blood flow

patterns within the thyroid tissue. It aids in diagnosing both diffuse and nodular thyroid diseases. When suspicious nodules are identified, ultrasound guides healthcare professionals in performing FNAC to assess potential malignancy.^[7]

While various imaging modalities are available for goitre evaluation, HPE and FNAC remain essential for a definitive diagnosis. FNAC has limitations, emphasizing the significance of histopathological examination as the conclusive diagnostic test.^[8]

Ultrasonography's superficial location offers real-time images of normal and pathological thyroid conditions. It helps measure tumor size, identify multinodularity, and rule out disease on the contralateral side.^[9]

In evaluating nodular thyroid conditions, sonography plays a pivotal role in locating neck masses, characterizing nodules, detecting acute nodules in high-risk patients, assessing known thyroid malignancies, identifying residual or recurrent carcinomas, detecting metastatic carcinoma, and guiding fine needle aspiration of thyroid nodules or cervical lymph nodes.^[10]

The objective of the study was to evaluate ultrasonography as a prime diagnostic imaging

modality for those patients with clinical features suggestive of thyroid lesions.

MATERIALS AND METHODS

A cross-sectional study was conducted from October 2013 to July 2015. Based on the inclusion and exclusion criteria, 70 cases of thyroid lesions diagnosed by ultrasound were included in the study. The ultrasound examination was done in the Department of Radiology of Aarupadai veedu Medical College and Hospital, Pondicherry. These 70 cases which were found to have thyroid lesions on ultrasound were subjected to FNAC for confirmation of ultrasound findings and establishment of the final diagnosis.

Inclusion Criteria

All patients with clinically palpable swelling in the thyroid region, congenital abnormalities of the thyroid gland, clinical suspicion of thyroid dysfunction and patients complaining of pain in thyroid region were included in the present study.

Exclusion Criteria

Patients with secondaries in the neck, swelling in the neck other than thyroid, ectopic thyroid, post-operative recurrences and patients with post-radiotherapy and post radio isotopic therapy of thyroid were excluded from the study.

Methodology

Equipment: In the present study gray scale real time ultrasound examination was using 7.5 to 10 MHz, linear array transducer was used at Aarupadai Veedu medical college Hospitals, Pondicherry.

Ultrasound Machine used are: GE Voluson S6

The technique of Examination: The patient is examined in the supine position with an extended neck. A pillow is placed under the shoulders to provide better exposure of the neck. Since the gland is situated superficially, a 7.5 MHz linear array transducer is used. The entire thyroid from the upper to the lower pole and the isthmus are examined in the longitudinal and transverse planes. The region of the carotid arteries and jugular veins laterally and supra clavicular fossa are also examined for any lymphadenopathy.

Scanning Technique

- Neck Palpation: Before beginning, the patient's neck is palpated to find the size and location of nodules and tenderness if any. It is better to ask the patient to swallow as the thyroid is being palpated.
- Scan image size: Enlarge the image of the thyroid gland to fill the entire viewing monitor which will include carotids and jugulars in the field.
- Transverse scan direction: Beginning transversely in the mid-point of the neck until thyroid tissue is identified. If the size of the thyroid mass is large and if it is not possible to image the right and left lobes simultaneously, then two lobes are examined separately and later the texture is compared bilaterally.
- Longitudinal scan direction: After imaging the carotid artery longitudinally, then probe is slid

medially to view the thyroid gland. If needed, the transducer is angulated 10 – 20 degrees medially. This technique is very useful to determine if the mass is within the thyroid gland or is extra thyroidal. Most extra thyroidal masses displace the carotid artery and internal jugular vein medially.

FNAC Technique:

Prior to conducting the ultrasound-guided fine needle aspiration cytology (FNAC), the neck is hyperextended, and the skin is prepared with a solution of povidone-iodine (Betadine). The transducer is also cleaned using the same solution, and a sterile gel serves as the coupling agent. In our study, we utilized a 7.5 MHz linear transducer for performing the FNAC. During the procedure, one hand holds the needle while the other hand operates the transducer. The needle is then inserted through the skin of the thyroid region at the front of the neck, following an oblique angle within the transducer's image plane.

Standard 11/2" 25 gauge, non-cutting, beveled edge needles are used for thyroid FNAC. The 10ml syringe has the needle connected. Under US supervision, the needle is inserted and then swiftly yet softly dragged through the nodule's core. The syringe's piston is then inserted to provide a mild suction. A non-aspiration approach is utilized if the specimen has a lot of blood in it. In this procedure, a 25-gauge needle is introduced into the thyroid gland with ultrasound guidance. No suction is used, and the needle is moved in back-and-forth excursions. The fluid of cells from the nodule was forced into the needle by capillary action, and as a result, the fluid sample is frequently less bloody.

A clean slide is covered with two drops of the aspirate or fluid from the syringe, and with the aid of another blank slide held at a 60° angle, the aspirate on the first slide is spread out to create a coating layer on it. The slide-making process is then repeated, and once the second slide has been smeared, the slides are placed in a jar with 100% alcohol for fixation. These two alcohol-soaked slides and their container were delivered to the pathology department for cytopathological analysis.

RESULTS

Present cross section study was conducted from October 2013 to July 2015. Based on the inclusion and exclusion criteria, 70 cases of thyroid lesions diagnosed by ultrasound were included in the study. The female predominance 49(70%) was reported in present study with majority of patients 29(41.4%) in age group of age group of 31-40 years. The maximum cases of thyroid swelling was observed on both sides 23(32.8%). Out of 59 swelling cases, maximum time duration of swelling cases 26 (44.1%) is observed to be 7 months to 1 year. The movement of swelling was observed positive in 59 (84.3%). The consistency of thyroid swelling was found soft in most of cases 27 (45.8%) [Table 1].

It is seen that the lesion site in maximum number of cases through ultrasound were seen in both lobe 32 (45.7%). The echo texture of lobe in maximum number of cases noted were Hyperechoic 22 (31.2%), followed by Iso echoic 20 (28.6%). The single nodules was reported in maximum number of patients 48 (68.5%). Among all patients calcification was seen in 10 (14.3%) cases. Among calcification, micro calcification was seen in 6 (80%) cases and macro calcification was seen in 4 (40%) cases. The involvement of lymph nodes in thyroid cases was seen in 6 (7%) patients. The ultrasound was able to detect Adenomatous nodule in 27 (38.8%) patients and colloid cyst in 16 (22.9%) and Multinodular goitre in 12 (17.2%). In the study, maximum number of cases observed by FNAC test are Adenoma cases 28 (40%), followed by colloid goiter 20 (28.6%) and Multinodular goitre 12 (17.2%) [Figure 1].

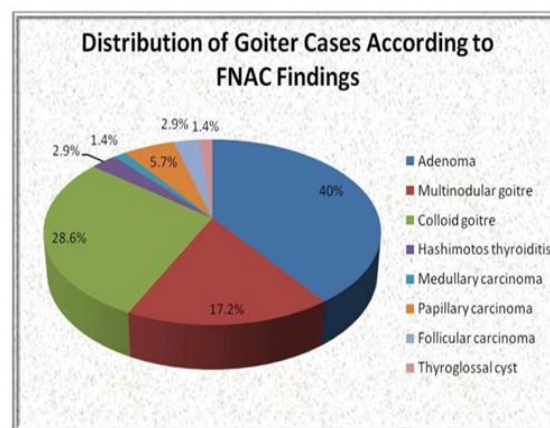


Figure 1: Distribution of goiter cases as per FNAC findings

Table 1: Demographic parameters of patients

Parameters	Observations Frequency (%)
Gender	
Male	21 (30%)
Female	49 (70%)
Age Group (Years)	
11-20	03 (4.3%)
21-30	13 (18.6%)
31-40	29 (41.4%)
41-50	18 (25.7%)
51-60	06 (8.6%)
61-70	01 (1.4%)

Table 2: Site and duration of swelling

Parameters	Observations Frequency (%)
Site of Swelling	
Left Side	05 (7.1%)
Right Side	14 (20.0%)
Mid Line	17 (24.4%)
Both Sides	23 (32.8%)
Total Swellings	59 (84.3%)
No Swelling	11 (15.7%)
Duration	
0 – 6 Months	21 (35.6%)
7 – 1 Year	26 (44.1%)
1.1 – 2 Years	09 (15.2%)
> 2 Years	03 (5.1%)

Table 3: Clinical characteristics

Movement of Swelling	
Positive	59 (84.3%)
Negative	11 (15.7%)
Consistency of Thyroid Swelling	
Soft	27 (45.8%)
Solid	10 (17.0%)
Nodular	15 (25.4%)
Firm	3 (5.0%)
Hard	4 (6.8%)
Site of lesion	
Left Lobe	20 (28.6%)
Right Lobe	15 (21.4%)
Both Lobe	32 (45.7%)
Isthmus	3 (4.3%)
Echo textures of the nodules	
Iso echoic	20 (28.6%)
Hypo echoic	22 (31.4%)
Hyper echoic	06 (8.6%)
Heterogenous	12 (17.2%)
Anechoic cyst	5 (7.1%)

Heterogenous with cystic changes	1 (1.4%)
Left heterogenous and Right Iso	3 (4.3%)
Normal	1 (1.4%)
No. of Nodules Present	
Single	48 68.5
Multiple	12 17.1
Diffuse	4 5.7
No Nodules	6 8.5

Table 4: Distribution of Goiter cases

Parameters	Observations Frequency (%)
Goitre cases as per calcification	
Micro	6 (80%)
Macro	4 (40%)
Involvement of lymph node	
Lymph node	6 (7%)
Absent	64 (93%)
Goiter Cases According to FNAC Findings	
Adenoma	28 (40%)
Multinodular goitre	12 (17.2%)
Colloid goitre	20 (28.6%)
Hashimotos thyroiditis	2 (2.9%)
Medullary carcinoma	1 (1.4%)
Papillary carcinoma	4 (5.7%)
Follicular carcinoma	2 (2.9%)
Thyroglossal cyst	1 (1.4%)

Table 5: Observation USG finding among patients

Ultrasound Findings	Observations Frequency (%)
Adenomatous nodule	27 (38.8%)
Multinodular goitre	12 (17.2%)
Colloid cyst	16 (22.9%)
Hashimotos thyroidites	2 (2.8%)
Carcinoma	6 (8.6%)
Diffuse hypertrophy of thyroid gland	4 (5.8%)
Hyperplastic nodule with degenerative changes	3 (4.3%)

DISCUSSION

A total of 70 patients with various thyroid disorders formed the study sample investigated by ultrasonography. In present study out of 70 patients with various thyroid disorders, maximum number of cases were found from 3rd to 5th decade and most of the lesions were seen in females (70%) as compared to males (30%). In a study conducted by Wienke et al., with an age range of 20 – 60 years, in patients with thyroid nodules most of the patients were in the age group of 3rd to 5th decade and out of 68 cases 63 were females and 7 were males constituting a ratio of 4.^[10]

In present study out of 70 cases, 48 cases had solitary thyroid nodules and 12 patients had multiple nodules. Study conducted by Frates et al., out of 1985 patients 1181 patients had solitary thyroid nodules and 708 patients had multiple nodules.^[11]

The ultrasound was able to detect Adenomatous nodule in 27 (38.8%) patients and colloid cyst in 16 (22.9%) and Multinodular goitre in 12 (17.2%). In a study conducted by Winke et al., on 82 thyroid nodules of which 41 revealed to be adenomas 27 cases were colloid cyst.¹⁰ Kaur et al., out of 50 cases of STN, 20 cases were adenoma (40%) colloid in 14 (28%) and thyroiditis in 3 cases.^[12]

Present study out of 56 benign thyroid nodules, 28 were adenomas, 20 cases were colloid goiter and 12

cases were multinodular goiter. Of the 27 adenomas, USG revealed hypoechoic nodule in 15 cases, isoechoic in 10 cases and 2 cases revealed hetro with cystic changes. Peripheral halosign was seen in 3 cases and macro calcification was present in 4 cases. Kaur et al., conducted a study on 50 thyroid nodules of which 41 nodules were benign and 9 malignant sonographic characteristics of benign nodules were predominantly hypoechoic solid were 38 mixed 8 and cystic lesions were 4 lesions.¹² In another study conducted by Frates et al., out of 865 patients, 771 were benign and 94 were malignant. Of 771 benign nodules, 330 were completely solid and 209 were predominantly solid, 130 were mixed solid and cystic, 85 were predominantly cystic and 17 were completely cystic. 295 nodules were totally hypoechoic, macrocalcification in 79 patients. Halo was present around 460 nodules.^[11]

In current study out of 70 cases, carcinoma was diagnosed on FNAC by 7 cases of which papillary carcinoma was 4, medullary 1 and follicular carcinoma 2. Alauddin et al., studied thyroid swelling cases in 1140 patients of which 154 were malignant of which 98 were papillary thyroid carcinoma and 32 were follicular carcinoma and 6 were medullary carcinoma.^[13]

In present study, our study cases diagnosed with papillary carcinoma revealed following features - hypoechoogenicity in 3 cases. 1 case was heterogenous

with multiple nodules, micro calcification was present in all 4 cases and lymphnode invasion was seen in all the cases. Wesley et al., studied features of papillary carcinoma in 106 nodules which revealed hypo echogenicity in 90.5% no calcification in 59.4% and micro calcification in 264%.^[14]

In present study total of seven cases, only 2 cases were diagnosed as follicular carcinoma on HPE. Ultrasound revealed solid hypoechoic pattern with no cystic component with irregular margins. In a study conducted by Kaur et al., of the 9 malignant cases 2 cases were diagnosed as follicular carcinoma which revealed similar findings of hypoechoic nodule with irregular margins and no cystic component.^[12]

In our study, 1 case is diagnosed by HPE as medullary carcinoma. USG showed a solid hypoechoic pattern with microcalcification and posterior acoustic shadowing. The lesion showed irregular margins and no peripheral halo. Solbiati et al., conducted a study in which a total of 9 cases with 9 nodules were histopathologically proved to be the cases of medullary carcinoma, which revealed a solid isoechoic lesion in 3 of 9 cases and all the 9 nodules had irregular margins and none of them had a peripheral halo around it.^[15]

In our study total of two patients of thyroiditis were part of our study sample. Both the cases revealed diffuse hypoechoogenicity of the gland with altered echotexture. On HPE they were proved to be hashimotos thyroiditis which is the most common form of thyroiditis. Joseph FS., all 12 cases of Hashimotos showed a gland with diffuse hypoechoogenicity and heterogenous echotexture.^[16]

CONCLUSION

The thyroid's superficial location, vascularity, size, and echogenicity make it an ideal candidate for ultrasound examination. Over time, the application of thyroid ultrasound has extended beyond its initial diagnostic purposes. The use of highly sensitive probes enables precise characterization of thyroid nodules and lymph nodes. This heightened sensitivity in ultrasonography aids in detecting small occult nodules that might be overlooked during a conventional clinical examination. Ultrasonography plays a significant role in characterizing thyroid nodules and diffuse thyroid diseases. The ultrasound

features of nodules, such as hypoechoogenicity, microcalcification, hypoechoic halo, and irregular margins, are valuable in distinguishing between benign and malignant lesions.

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