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High frequency sonographic evaluation of thyroid lesions

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Abstract
Aim: To evaluate the role of ultrasound as the primary diagnostic imaging modality in thyroid disease.
Methodology: Patients suspected to have thyroid disease were included in the study. Ultrasound was done as initial diagnostic imaging method for thyroid lesions and evaluated accordingly. These thyroid lesions were subjected to ultrasound guided FNAC, for confirmation of diagnosis. Later the validity of ultrasound diagnosis in relation to FNAC diagnosis was studied.
Results: Ultrasonography showed relatively high sensitivity and specificity for diagnosing and characterizing thyroid disease. For thyroid adenomas, colloid cyst and multinodular goiter, 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 relatively high diagnostic rate. USG guided FNAC was a safe procedure and yielded high diagnostic yield for detection of thyroid diseases.
Conclusion: Above data suggests that USG can be used as a primary imaging modality with high sensitivity and specificity for overall diagnosis and characterization of thyroid diseases. USG helps in guiding FNAC for confirmation of diagnosis.

Keywords: Thyroid diseases, ultrasonography, fine needle aspiration

Introduction
Disorders of thyroid gland are very common in clinical practice. Thyroid diseases are most common among all the endocrine diseases in India. Ultrasonography is relatively cheap, easily accessible, rapidly performed and has advantage of no exposure to ionizing radiation.
Since the thyroid gland is superficially located, high resolution real time gray scale, sonography can demonstrate normal thyroid anatomy and pathologic conditions with remarkable clarity. As a result, this technique has come to play an increasingly important role in the diagnostic evaluation of thyroid diseases[1]. Neoplasm of thyroid may be benign or malignant. USG of the thyroid helps in measuring the tumour size, diagnosing multinodularity and excluding contralateral disease.
USG can also suspect malignancy in a lesion on the basis of certain sonographic characteristics and further categorize it into papillary, follicular, anaplastic.
So the basic use of sonography for the evaluation of nodular thyroid is to:

- Determine location of palpable neck mass example thyroid or extra thyroid.
- Characterize benign or malignant nodule features.
- Detect acute nodule in a patient with history of head and neck irradiation or MEN II syndrome.
- Determine extent of known thyroid malignancy.
- Determine residual or recurrent and metastatic carcinoma.
- Guide fine needle aspiration of thyroid nodule or cervical lymph node [2].

The objective of study was to correlate the number, size and extent of the nodules as determined during the pre-operative clinical examination of the thyroid gland, USG, intraoperative examination and histopathology.

Methodology
Cross section study was conducted from 1st March 2018 to 28th February 2019. 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 Radiodiagnosis of General Hospital attached to SVS Medical College, Mahabubnagar.
These 70 cases which were found to have thyroid lesion on ultrasound were subjected to FNAC for confirmation of ultrasound finding and establishment of final diagnosis.

Following inclusion and exclusion criteria were used for selection of cases for the present study.

1. Inclusion criteria
2. Exclusion criteria

Inclusion criteria

1. Patients presenting with clinically palpable swelling in the thyroid region.
2. Patients presenting with congenital abnormalities of thyroid gland.
3. Patients with clinical suspicion of thyroid dysfunction.
4. Patients complaining of pain in thyroid region.

Exclusion criteria

1. Secondaries in the neck.
2. Swelling in the neck other than thyroid.
3. Ectopic thyroid.
4. Post-operative recurrences.
5. Post-radiotherapy and post radio isotopic therapy of thyroid.

Equipment

In the present study gray scale real time ultrasound examination was using 7.5 to 10 MHz, liner array transducer was used at SVS Medical College & General Hospital.

Ultrasound machine used are

- AFFINITI 70G

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, 7.5 MHz linear array transducer is used.

The entire thyroid from upper to the lower pole and the isthmus are examined in the longitudinal and transverse planes. The region of the carotid arteries and jugular vines laterally and supra clavicular fossa are also examined for any lymphadenopathy.

Scanning technique

1. Neck Palpation: Before beginning, patient's neck is palpated to find the size and location of nodule and tenderness if any. It is better to ask the patient to swallow as the thyroid is being palpated.
2. 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.
3. 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 right and left lobes simultaneously, then two lobes are examined separately and later the texture compared bilaterally.
4. Longitudinal scan direction: After imaging the carotid artery longitudinally then probe is slided 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 vine medially

FNAC technique

Before the ultrasound guided FNAC, the neck is hyperextended and the skin is cleansed with povidone – iodine (Betadine) solution. The transducer is also cleasnsed with same solution. Sterile gel is used as a coupling agent. In our study we used 7.5 MHz linear transducer to take FNAC. Then the needle is held in one hand and the transducer in the other. The needle is inserted through the skin of thyroid region in front of the neck at an oblique angle within the image plane of transducer.

The needle used for thyroid FNAC is standard 1½" 25 gauge, non-cutting beveled edge needle. The needle is attached to 10ml syringe. After introducing the needle, the needle is moved gently but rapidly through the nodule center under US guidance.

Results

Table 1: Age and sex wise distribution of thyroid swelling cases

Age in years	Sex					
	Male		Female		Total	
	No.	%	No.	%	No.	%
11-20	01	1.4	02	2.9	03	4.3
21-30	04	5.7	09	12.9	13	18.6
31-40	08	11.5	21	30.0	29	41.4
41-50	05	7.1	13	18.5	18	25.7
51-60	02	2.9	04	5.7	06	8.6
61-70	01	1.4	00	0.0	01	1.4
Total	21	30	49	70	70	100

In the study, the youngest patient was 11 years of age and oldest 70 years. The maximum number of cases in the age group of 31-40 (41%) and 41-50 (25.7%) and female predominating (70%) over males 30%).

Table 2: Distribution of cases according to site of swelling

Site of swelling	No. of cases	Percentage
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
Total	70	100

In the study, in maximum cases swelling was observed on both sides (32.8%) followed by midline (24.1%) and right side (20.0%). Lowest swelling sites observed on left side (7.1%). Total cases of swelling are more (84.3%) as compared to non-swelling cases (15.7%).

Table 3: Classification of cases according to duration of swelling

Duration	No. of cases	Percentage
0 – 6 Months	21	35.6
7 – 1 Year	26	44.1
1.1 – 2 Years	09	15.2
> 2 Years	03	05.1
Total	59	100

Out of 59 swelling cases, maximum time duration of swelling cases is observed to be 7 months to 1 year i.e., (44.1%) and minimum time duration of swelling cases is more than 2 years i.e., (51%).

Table 4: Movement of swelling

Movement	No. of cases	Percentage
Positive	59	84.3
Negative	11	15.7
Total	70	100

Table 5: Clinical examination of consistency of thyroid swelling

Consistency	No. of cases	Percentage
Soft	27	45.8
Solid	10	17.0
Nodular	15	25.4
Firm	03	05.0
Hard	04	6.8
Total	59	100

It was observed that among 59 patients of thyroid swelling most common consistency was soft i.e., 27 (45.8%), followed by nodular 15 (25.4%), firm 3 (5.0%) and hard 4 (6.8%).

Table 6: Distribution of cases according to site of lesion on ultrasound

Lesion	No. of cases	Percentage
Left Lobe	20	28.6
Right Lobe	15	21.4
Both Lobe	32	45.7
Isthmus	03	4.3
Total	70	100

It is seen that the lesion site in maximum number of cases through ultrasound were seen in both lobe i.e., 32 (45.7%) followed by left lobe and right lobe 20 (28.6%) and 15 (21.4%) respectively. The minimum number of lesion site was seen at Isthmus 3 (4.3%).

Table 7: Distribution of cases according to echo textures of the nodules

Echotextures	No. of Cases	Percentage
Iso echoic	20	28.6
Hypo echoic	22	31.4
Hyper echoic	06	8.6
Hetrogenous	12	17.2
Anechoic cyst	05	7.1
Hetrogenous with cystic changes	01	1.4
Left hetrogenous and Right Iso	03	4.3
Normal	01	1.4
Total	70	100

In the study it revealed that the echo texture of lobe in maximum number of cases seen are Hyperechoic 22 (31.2%), followed by Iso echoic 20 (28.6%) and Hetrogenous in 12 (17.2).

Table 8: Nodules Wise Distribution of Cases

No. of Nodules Present	No. of Cases	Percentage
Single	52	74.3
Multiple	18	25.7
Diffuse	04	5.6
No Nodules	06	8.5
Total	70	100

It is observed that most of the cases are multiple nodules 32 (45.7%), followed by single nodule cases 18 (25.7%) and diffused cases are less 4 (5.6%).

Table 9: Distribution of goiter cases according to calcification

Calcification	No. of cases	Percentage
Micro	06	80
Macro	04	40
Total	10	100

It is observed that out of 70 thyroid cases, 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.

Table 10: Distribution of thyroid cases according to involvement of lymph node

	Present study	Abstract	Total
Lymphnode	6	64	70
Percentage	7.0	93.0	100

Out of 70 thyroid cases, involvement of lymph nodes was seen in 6 cases (7%) and no involvement of lymph node in 64 (93%).

Table 11: Overview of various ultrasound findings

Ultrasound findings	No. of cases	Percentage
Adenomatous nodule	27	38.8
Multinodular goitre	12	17.2
Colloid cyst	16	22.9
Hashimotos thyroidites	02	2.8
Carcinoma	06	8.6
Diffuse hypertrophy of thyroid gland	04	5.8
Hyperplastic nodule with degenerative changes	03	4.3
Total	70	100

The above table show that ultrasound can detect Adenomatous nodule in 27 (38.8%) patients and colloid cyst in 16 (22.9%) and Multinodular goitre in 12 (17.2%) cases.

Table 12: Distribution of goiter cases according to FNAC findings

Findings	No. of cases	Percentage
Adenoma	28	40
Multinodular goitre	12	17.2
Colloid goitre	20	28.6
Hashimotos thyroiditis	02	2.9
Medullary carcinoma	01	1.4
Papillary carcinoma	04	5.7
Follicular carcinoma	02	2.9
Thyroglossal cyst	01	1.4
Total	70	100

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%).

Fig 1: Ultrasound equipment – AFFINITI 70G

Fig 2: Ultrasound transducer

Discussion

A total of 70 patients with various thyroid disorders formed the study sample investigated by ultrasonography.

Age and sex distribution

1. In a study conducted by Jeffery R. 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 [3].
2. In a retrospective study carried out by Uzma Bukkari *et al*., thyroid lesions were received in 158 cases of which 138 cases were female and males were 27 cases, Female to male ratio of 4.7:1. Most of the cases were found in the age group of 3rd to 5th decade [4].

Solitary thyroid nodules

1. In a study conducted by C. Cappelli *et al*., a total of 61, 35 nodules were obtained of which 4495 patient's solitary nodules and 1231 patients had had multiple nodules [5].
2. Study conducted by Mary *et al*., out of 1985 patients 1181 patients had solitary thyroid nodules and 708 patients had multiple nodules [6].
3. In present study out of 70 cases, 56 cases had solitary thyroid nodules and 12 patients had multiple nodules.

Adenoma

1. In a study conducted by Jeffery R. Winke *et al*., on 82 thyroid nodules of which 41 revealed to be adenomas 27 cases were colloid cyst [3].
2. In a study carried out on 50 cases by Kamaljit Kaur *et al*., out of 50 cases of STN, 20 cases were adenoma (40%) colloid in 14 (28%) and thyroiditis in 3 cases [7].

USG features of adenoma

1. In a study conducted by Mary C. Fratis, Carol B. Benson *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, 129 were mixed solid and cystic, 85 were predominantly cystic and seven were completely cystic. 295 nodules were totally hypoechoic, macrocalcification in 79 patients. Halo was present around 460 nodules [6].
2. 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.

Papillary carcinoma

1. Pedrowesllly *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 [8].
2. Uzma Bukhari *et al*., studied about 998 thyroid lesionsof which 153 cases were malignant and papillary carcinoma was the most common malignant lesion with a frequency of 90.2%, followed by medullary carcinoma of 4.5% and 2% for follicular carcinoma [4].
3. Present 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.

USG features of papillary carcinoma

1. Kamaljit Kaur *et al*., studied 50 cases of STN of which 9 cases were malignant and USG's features S/o of malignancy are hypoechoic pattern, microcalcifications and presence of cervical lymphadenopathy [7].
2. In present study, our study cases diagnosed with

papillary carcinoma revealed following features - hypoechogenicity in 3 cases. 1 case was hetrogenous with multiple nodules, micro calcification was present in all 4 cases and lymphnode invasion was seen in all the cases.

Follicular carcinoma

1. Present study: In a total of seven cases, only 2 cases were diagnosed as follicular carcinoma on HPE.
   Ultrasound: Ultrasound revealed solid hypoechoic pattern with no cystic component with irregular margins.
2. In a study conducted by Kamaljit 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 [7].

Medullary carcinoma

1. In our study, 1 case is diagnosed by HPE as medullary carcinoma. USG showed a solid hypoechoic pattern with microcalcification and posterior acoustic shodowing. The lesion showed irregular margins and no peripheral halo.
2. Solbiatial *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 [9].

Hashimoto's thyroiditis

1. In a study conducted by Joseph FS., all 12 cases of Hashimotos showed a gland with diffuse hypoechogenicity and hetrogenous echotexture [10].
2. Present study: A total of two patients of thyroiditis were part of our study sample. Both the cases revealed diffuse hypoechogenicity of the gland with altered echotexture. On HPE they were proven to represent hashimotos thyroiditis which is the most common form of thyroiditis.

Conclusion

Ultrasound was clearly able to depict solitary nodules in more than 50% of our cases (of which around 38.8% were adenomatous lesion and around 22% were colloid cyst). The diffuse heterogenous echotexture of the gland with characteristic hypoechoic nodules clearly helps us in diagnosing Hashimotos thyroiditis (2 cases in our study revealed the above features). Ultrasound clearly helps to differentiate between micro and macro calcification and lymphnode involvement. Micro calcification and lymph node involvement are most commonly seen in most of thyroid carcinoma. (In our study micro calcification and lymph node involvement were seen in 4 cases and 6 cases respectively of thyroid carcinoma). Being a safe, simple, repeatable and without radiation exposure to the patient, it is worthy of being included in routine diagnostic work up.

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