ULTRASOUND EVALUATION OF THYROID DISEASES

Battula Venkateswarlu[1]

[1]*Professor, Department of Radio-diagnosis, Alluri Sitaramaraju Academy of Medical Sciences.*

ABSTRACT

AIMS & OBJECTIVES:

1. To differentiate cystic lesions from solid lesions.
2. The possibility to differentiate the intrinsic thyroid lesions from those arising from adjoining structures.
3. To evaluate the neoplasms and to differentiate benign from malignant lesions by USG characteristics and to correlate with FNAC reports.
4. Role of USG in rapidly growing thyroid lesions: To differentiate haemorrhage into the cystic lesions and rapidly growing malignant tumours.
5. Compare the results of our study with similar studies available in the present literature.

MATERIALS & METHODS

This study included 75 patients who attended outpatient departments of the Endocrinology, Medical and Surgical Units and also those who were inpatients.

RESULTS

Broadly pathological conditions of thyroid glands can be divided into nodular and diffuse thyroid diseases.

Among Nodular Diseases

Majority are benign, only few are malignant.

Characteristics of benign lesions are:

1. Well-differentiated margins.
2. Thin complete peripheral sonolucent halo.
3. Coarse peripheral calcifications.

Characteristics of malignant nodules are:

1. Ill-defined margins.
2. Thick incomplete peripheral halo.
3. Fine punctuate calcifications.

Diffuse Thyroid Diseases

1. Hashimoto's thyroiditis: Painless diffuse enlargement of thyroid gland usually in women with coarse echotexture and no normal gland tissue. There may be discrete hypoechoic nodules within it with cervical lymphadenopathy.
2. Goitres: a) Simple diffuse goitre: Symmetrical enlargement of gland without tenderness or bruit or lymphadenopathy, T3, T4 and TSH are within normal limits and no thyroid autoantibodies in the serum.
   a) Diffuse Toxic goitre: Diffuse enlargement of gland with increased vascularity on colour Doppler study.
   b) Multinodular goitre: Multiple hypoechoic nodule within normal thyroid parenchyma.
   c) Colloid goitre: Present as single or multiple swellings in the thyroid gland.

CONCLUSION

USG is the fast and cost effective modality of imaging investigations of choice in thyroid diseases. It helps to know:

1. Whether patient has focal or diffuse abnormality.
2. Whether lesions are solitary or multiple.
3. Whether they are cystic or solid.
4. Whether the lesion is benign or malignant can be differentiated by sonographic characteristics.
5. Further Hashimoto's thyroiditis or toxic goitre can be successfully differentiated by USG and colour Doppler findings.
6. US guided FNAC is the confirmatory tool.

KEYWORDS

USG, B-mode- Black and White, Colour Flow Doppler Machine.

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Corresponding Author:
Dr. Battula Venkateswarlu,
Professor, Department of Radio-diagnosis,
Alluri Sitaramaraju Academy of Medical Sciences.
E-mail: venbatulla@yahoo.co.in
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INTRODUCTION: High resolution sonography is the first choice in the evaluation of thyroid diseases because its sensitivity of detection of small thyroid lesions is considered superior to the scintigraphy.

CT, MRI are not as sensitive as USG except only for evaluation of mediastinal extension of thyroid masses.

Sonography is also used to differentiate thyroid from extra-thyroidal masses.

Useful for followup of patients for response to therapy and also to guide fine needle aspiration.

MATERIALS & METHODS:

Instrumentation: Philips HD 11 Xe-2 system was used for USG examination of the above patients.

This equipment has following features:

1. 2D real time B-mode-black and white and colour flow Doppler, M-mode, and duplex pulsed Doppler imaging modes.
2. Monitor has features of gray scale system as well as colour imaging system.
3. Zooming of the real time or frozen 2D images are possible.
4. There are 2 transducers: a) 3.5 MHz convex transducer b) 5.0 MHz linear array transducer.

Technique of Examination: The patient is examined in supine position with extended neck and pillow underneath the shoulders.

Since the gland is situated superficially 7.5 MHz linear array transducer is used.

The entire gland from upper to lower pole and the isthmus is examined in longitudinal and transverse planes.

The regions of carotid arteries and jugular veins laterally and supraclavicular fossa are also examined for any lymphadenopathy.

Inclusion & Exclusion Criteria:

Inclusion Criteria	Exclusion Criteria
Age: 11-60 yrs. History of neck swelling with or without pain. Hoarseness of voice, dysphagia and fatigue. Exophthalmos and tremors.	Swellings arising from the structures adjacent to thyroid gland. Eg: Lymph nodal enlargement. Abscesses, vascular lesions.

OBSERVATIONS & RESULTS: Our study was a hospital based study of 75 patients with clinical suspicion of thyroid disease, out of them 70 patients have thyroid lesions, 5 patient have extra-thyroid lesions.

Patients were of the age group between 11 and 60 years, females formed the majority 52 females and 23 males.

Age	Male	Female	Total
11 – 20	1	4	5
21 – 30	9	22	31
31 – 40	5	18	23
41 – 50	3	5	8
51 – 60	5	3	8
Total	**23**	**52**	**75**
Demographic data of thyroid swellings			

In our study, the youngest patient was 17 yrs. of age and oldest 60 yrs. The maximum number of patients were in 3rd and 4th decades, females predominating (69%) over males (31%).

Hyperthyroidism with mass in the neck	Hypothyroidism with mass in the neck	Euthyroid with mass in the neck	Total
5(7%)	42(60%)	23(33%)	70
Hormonal status of thyroid swelling patients			

(A)Diffuse goitre patients			(B) Multinodular goitre	(C) Colloid goitre	Total
Simple diffuse goitre	Diffuse toxic goitre	Toxic nodular goitre			
3 (8%)	1(3%)	4(11%)	10(27%)	19 (51%)	37 (100%)
Prevalence of Goitre in patients with thyroid swelling					

In this study, the incidence of colloid goitre was more than multinodular goitre. We had the lowest incidence of diffuse toxic goitre.

The multiple hypoechoic nodules with adjacent normal thyroid tissue was seen in 6/37 (16%), multiple hyperechoic nodules with normal adjacent parenchyma were seen less frequently in 4/37 (11%) patients.

Generalised enlargement of thyroid gland with hypoechogenicity and increased vascularity	1/37	3%
Enlargement of gland with multiple nodules of hypoechogenicity and increased vascularity	4/37	11%
Toxic goitres		

Almost all toxic goitres in our study 5/37 cases showed increased vascularity on colour Doppler study.

Generalised enlargement with multiple nodules of hypoechogenicity 80% (4 out of 5 patients) and 20% (1 out of 5 patients) showing homogenous hypoechogenicity.

USG characters	No. of cases	%
1. Diffusely & homogenously enlarged gland with well-preserved thyroid architecture	3/37	8%
2. Echogenicity iso to hypo	3/37	8%
Simple diffuse goitre		

Simple diffuse goitres were found only in 3 out of 37 goitre cases (8%), sonographically all cases were found to be having diffuse homogenous enlargement of the gland with well-preserved thyroid architecture. They have varied in echogenicity from iso echogenicity to hypoechogenicity.

USG characters	No. of cases	%
1. Diffuse gland enlargement with coarse echotexture and without any normal gland tissue	8/9	89%
2. Discrete hypoechogenic nodules	5/9	56%
3. Diffuse gland enlargement with coarse echotexture and without normal gland tissue associated with cervical lymphadenopathy	1/9	11%
Diffuse thyroid inflammatory disease		

Note: Each patient had more than one USG character.

A thyroid swelling can be emphatically diagnosed on ultrasound as Hashimoto's disease by the classical features of diffuse glandular swelling with coarse echotexture all round and no normal thyroid gland tissue at all in the vicinity which were seen in 8/9 patients (89%).

The less common discrete hypoechogenic nodules were observed 5/9 (56%) and only one patient had associated cervical lymphadenopathy.

DISCUSSION: The role of ultrasonography in the diagnosis of thyroid diseases is becoming increasingly important as it allows detection of small lesions of around 8 to 15 mm by Enrico Papini, Rinaldo Guglielmi, Antonio Bianchini (2001).[1] Same is our experience in present study.

The limitations of USG are: The quality of images as well as their interpretation is dependent on the expertise of the examiner.

Another limitation is that it is inferior to cross-sectional imaging techniques of CT & MRI in identifying lymphadenopathy or in evaluation of extension of thyroid disease into the soft tissues of neck or chest according to Laurie Aloevner (1996).[2]

The above statement is true to some extent. Our experience shows that the availability of high resolution, high frequency USG machine, these limitations have been overcome. It is also to be noted that the USG is cost effective and within the reach of every patient and some of those who cannot afford the cost of CT or MRI scans.

As quoted by T Bjoro, J Holmen, O Kruger (2000)[3] that the thyroid lesions show significantly higher incidence in females, our study also showed similar female preponderance.

The high prevalence of thyroid disease in the age group between 20-40 years, was quoted by Luigi Solbiati et al (1985).[4] In present study, we found that the age group of 20 to 40 years were the mostly affected people (55/70 patients) (79%).

The first goal of thyroid USG is to define whether the patient has a generalised abnormality, a multinodular pathology or a solitary nodule. Many combinations of these situations are possible. In our study, at USG, 39/70 lesions (56%) were found to be solitary nodular lesions; these included 15 thyroid adenomas, 19 colloid goitres, and 5 malignant solitary nodules.

There were 14/70 (20%) who showed multinodular lesions on USG in our study. Further in our study, 17/70 diffuse lesions were seen (24%). Of these 17 diffuse lesions, 9 patients had Hashimoto's thyroiditis (13%). Simple diffuse goitre was found in 3 patients (4%) while 5 patients (7%) were diagnosed to have toxic goitre.

According to Ousehal A et al (1994),[5] the characteristics of benign lesions were well-defined margin, thin complete peripheral sonolucent halo, and thick macro-calcifications found in 42/ 63 (66%). In our series 11/15 (73%), benign thyroid nodule patients showed the above features.

The remaining 9 patients (13%) of our study, the lesions were proved to be malignant on histopathological study; of the 9 malignancies, USG revealed multinodularity in 4 patients (6%), but in 5 patients (7%) they were solitary nodules.

USG Features	Present study	Series by Ousehal A et al (1994)
Well-defined margins Thin peripheral Complete sonolucent halo Thick Macro-calcifications	11/15 (73%)	42/63 (66%)
Comparison of US features of benign lesions		

Most malignancies were found among patients showing hypoechoic lesions on USG, in accordance with the available literature, quoted by Luigi Solbiati et al (1985).[4] They also emphasised that similar findings by Hales. J. Jellins et al (1978), Scheible. W. Lepold G.R. et al (1979). Espinasse -P et al (1979) and Simeone J.F et al (1982).

In our study also similar findings were noted - 5/9 (56%) malignancies as proved by HPS were found to be hypoechoic on USG.

Irregular, ill-defined margins with fine punctate micro-calcifications and incomplete, thick sonolucent halo are more common in malignant conditions according to Sunder K et al 1998. They quote Gimando et al (1994). In our series, the above findings of micro-calcifications, thick, incomplete peripheral halo were seen 7/9 (78%) and poorly defined margins in all 9/9 patients (100%).

Diffuse Thyroid Lesions: Diffuse thyroid lesions in our study consisted of:

1. Simple diffuse goitre.
2. Inflammatory diffuse thyroiditis.
3. Diffuse toxic goitre.
4. Toxic nodular goitre.

Benign adenomas		Malignant tumours	
Lin JD et al 1997	Present study	Lin JD et al 1997	Present study
63 out of 84 (75%)	15/24 (63%)	21/84(25%)	9/24(37%)
Comparison of prevalence of benign and malignant thyroid tumours on FNAC			

In both the above series, the results of Ultrasound guided Fine Needle Aspiration Cytology revealed benign adenomas to be more common.

Author	Hypoechogenicity with adjacent normal thyroid tissue	Percentage
Lin JD et al 1997	16 out of 21 cases	76%
Our study	5 out of 9 cases	55%
Comparison of hypoechogenicity in malignant conditions		

In our study malignant lesions 5 out of 9 cases (55%) showed hypo echogenicity with surrounding normal thyroid tissue, whereas in the series by Lin JD et al (1997) showed 16 out of 21 cases (76%). According to them, hypoechogenicity at USG suggests high risk of malignancy especially when accompanied by microcalcifications.

Author	No. of malignant lesions studied by USG	Ill-defined margins with incomplete sonolucent halo
Luigi Solbiati et al 1985	139	65/139 47%
Ousehal 1997	5	3/5 60%
Our study	9	9/9 100%
USG Feature of margins in malignant lesions		

The feature of ill-defined and irregular margins of the lesion with incomplete sonolucent halo suggest malignancy in both the above series and also that of ours. This goes to prove that the feature of ill-defined margins at USG with incomplete sonolucent halo is an useful paradigm to differentiate malignant lesion from benign lesions of thyroid.

Author	Total No. of cases of Malignant conditions	Micro-calcifications present
Luigi Solhiati et al 1992	307	257/307 83.8%
Our study	9	7/9 78%
USG Feature of micro-calcification in malignant conditions		

The presence of micro-calcifications in the thyroid lesions is definitely suggest malignancy. Hence, from all the above observations, hypoechogenicity is not the only diagnostic USG feature of malignancy, but when associated with ill-defined margins and micro-calcifications, we can differentiate malignant from benign lesions.

Author	Total No. of patients	Haemorrhage into nodule	Malignant tumours
King AD et al 1997	42	31/43 (74%)	11/42 (26%)
Our study	10	8/10 (80%)	2/10 (20%)
USG Evaluation of large rapidly growing thyroid mass lesions			

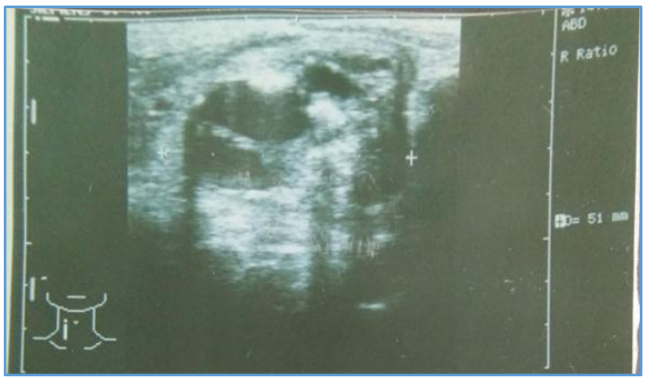
Of ultrasonography of the large rapidly growing thyroid lesions in 8 out of 10 cases (80%), of our study revealed that haemorrhage into thyroid nodule was the cause for sudden increase in size. Similarly, the study of King AD et al (1997) also revealed that at USG 31 out of 42 cases (74%), haemorrhage into the nodule occurred. But only 11 out of these 42(26%) cases turned out to be malignant on CD30 pathological study. Similar findings were seen in our study also where 2 out of 10 (20%) rapidly growing mass cases were reported by cytologist as malignant conditions. Hence, we can postulate that the sudden rapidity of growth in thyroid masses does not necessarily mean malignancy, but it was due to haemorrhage into the nodule.

In our series, 3/37(8%) showed diffuse and homogenous enlargement of thyroid gland, while thyroid architecture was well preserved. Their echogenicity varied from iso to hypo in 3/37 (8%) patients. According to Sunder K et al (1998), these simple adenomatous goitres with multiple hypoechoic nodules with adjacent normal parenchyma of thyroid gland, in between these nodules are characteristic of diffuse adenomatous goitre. They also quote Noun. A (1993). Similar findings were observed in our study also.

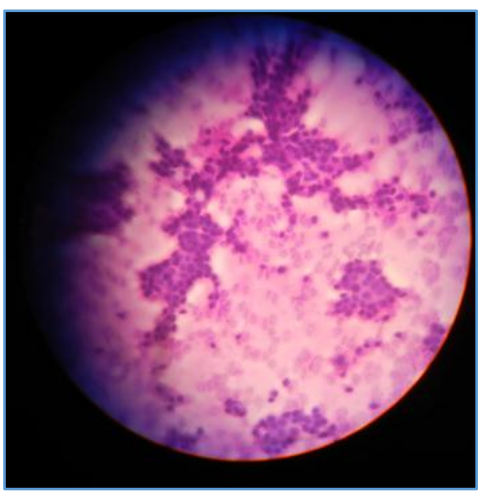
Graves' disease also produces diffuse enlargement of the gland seen at USG. In these patients, Colour Doppler scan shows a highly increased vascularity with increased flow during systole and diastole, a pattern which does not occur in any other thyroid diseases. According to Richard Hopkins, C (1995), Colour Doppler scan, a recently applied modality for thyroid study, has no proper correlation to the pathology in terms of the amount of internal flow. But our experience suggests that Colour Doppler scan is useful in differentiating the toxic nodular goitre from other type of goitres, based on the increased vascularity and flow pattern in this hyperdynamic condition. In our study, there were totally 5 patients with toxic goitre, all of these showed generalised enlargement of the gland with hypoechoic nodules. On Colour Doppler scan, all of them showed increased vascularity and increased flow pattern. The same findings were noted by Sunder K et al (1998).

CONCLUSION: It is concluded that USG is the fast and cost effective modality of imaging investigation of choice in thyroid diseases. It firstly helps to know whether the patient has a focal or diffuse thyroid abnormality. Then it allows us to know whether the lesion is solitary or multiple. It also helps to know whether they are cystic or solid. Further Hashimoto's thyroiditis and toxic goitres can be successfully differentiated from solitary and multinodular or toxic goitres entirely on the basis of USG and colour Doppler sonography findings respectively.

In addition to this, the typical USG features of malignancy such as irregular and ill-defined margins with incomplete thick sonolucent halo and the presence of micro-calcifications help to differentiate malignant thyroid lesion from benign thyroid lesions. US guided FNAC is the confirmatory tool. Thus, it is imperative to perform USG in all thyroid disease patients and subject them to US guided FNAC as and when in doubt.

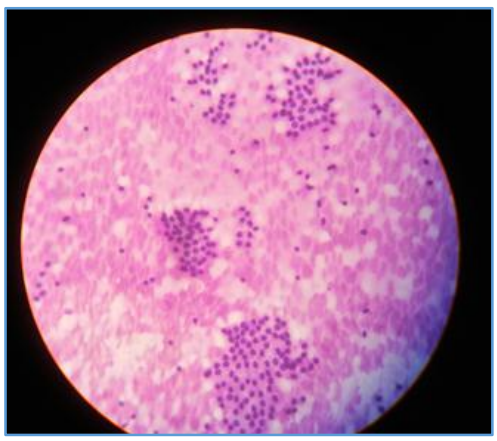


USG showing lesion with irregular margins and heterogenous echogenicity and cystic component in Rt. Lobe of Thyroid – FNAC – Carcinoma Thyroid



FNAC

USG showing small echogenic lesions in Rt lobe and another in the Lt lobe, S/o Multinodular Goitre



FNAC

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