



## Role of Color Doppler in evaluation of Thyroid Diseases

### KEYWORDS

Thyroid nodules, Color flow Doppler sonography, echogenicity, microcalcification,

**Dr B. Venkateswarulu**

Professor of Radiology ASRAM medical college,  
Eluru W.G.Dist, A.P, 534005

**Dr. Radhika Gowni**

Postgraduate of Radiology ASRAM Medical College  
,ELURU W.G.Dist, 534005, A.P

### ABSTRACT

*Thyroid ultrasound is very efficient in differentiating solid from cystic lesions, solitary nodules from multinodular and diffuse enlargement and extra thyroidal lesions. Color flow Doppler sonography is gaining importance for evaluation of the thyroid disorders. CFDS can differentiate between untreated Grave's disease from Hashimoto's thyroiditis which has similar gray scale findings. Acceptable ultrasonographic images and Doppler waveforms were obtained from all cases. All the cases were later subjected to F.N.A.C. Ultrasound was able to pick up lesions in all 40 cases with a sensitivity and specificity of 100%.*

### INTRODUCTION

The thyroid gland is highly vascular endocrine organ that maintains the normal growth and activity of humans. It is one of the major secreting organs, the secretion being generated by its own auto-regulatory mechanism. Any factor causing a discrepancy in the auto-regulatory function results in a spectrum of thyroid function disorders.

Iodine deficiency is one of the important causes for thyroid disorders<sup>1</sup>. The clinical spectrum of thyroid disease vary from simple goitre to malignancy. Epidemiologic studies estimate that 4 to 7% of adults have palpable nodules with women affected more frequently than men. The majority are benign, due to cysts, thyroiditis, adenomas, or colloid nodules. Although nodular thyroid disease is relatively common, thyroid cancers are rare and accounts for less than 1% of all malignant neoplasms. The overwhelming majority of thyroid nodules are benign. The clinical challenge is to distinguish the few clinically significant malignant nodules from the many benign nodules and thus identify patients who need surgical excision. This task is complicated because nodular disease of the thyroid gland often is clinically occult (<10-15 mm), although it can be readily detected by high-resolution sonography.

US, often the first imaging investigation, is of value in establishing whether a palpable nodule is solitary, cystic or part of a multinodular process such as multinodular goitres. In approximately 25% of patients, clinically solitary palpable nodules are shown by US to be multiple. Multinodular goitres have a lower incidence of malignancy (1-6%) than is associated with a single 'cold' nodule that is malignant (15-25% of cases).

Thyroid ultrasound differentiates solid from cystic lesions, solitary nodules from multinodular and diffuse enlargement and extrathyroidal lesions. Nearly 50% of patients with a clinically solitary thyroid nodule have avoided surgery by thyroid scanning<sup>2</sup>. The newly developed high resolution ultrasonography with color doppler flow mapping can reveal fine details of the thyroid gland and the haemodynamic features of thyroid neoplasms<sup>3</sup>. Thus the combination of conventional sonography and color flow doppler provides benefits in increasing the screening sensitivity and accuracy in distinguishing malignant thyroid nodules<sup>4</sup>.

### AIMS AND OBJECTIVES

1. To Study various ultrasonographic findings associated with Thyroid diseases.
2. To differentiate between benign and malignant thyroid nodules based on internal characteristics.
3. To study the vascular pattern of thyroid diseases using duplex sonography.

### PATIENTS AND METHODS

The present study is a time bound prospective color assisted duplex sonographic study of patients presenting with clinical suspicion of thyroid diseases referred to the department of radio-diagnosis from October-2014 to September- 2016. The patients so subjected to thyroid ultrasound later underwent ultrasound guided fine needle cytology of the lesions detected. Some of them underwent thyroidal hormonal assay depending on clinical suspicion.

Pre- designed proforma were used to collect all the relevant information which included patient data, clinical findings, laboratory reports and Doppler reports. Findings of the thyroid ultrasound scan were correlated with the clinical and laboratory findings.

The thyroid volume was calculated by ultrasound in each case with detailed evaluation of the sonographic pattern of the involved thyroid gland. Doppler examination was later done in each patients to determine the vascular anomalies of the gland. Evaluation of thyroid nodules and classification into benign and malignant nodules on the basis of sonographic patterns were also done in accordance to literature. The fine needle biopsy findings were later compared with the thyroid ultrasound diagnosis along with clinical correlation.

### INCLUSION CRITERIA

- Clinically suspected cases of thyroid diseases.
- As a pre-requisite before surgery in patients of thyroid diseases.

### EXCLUSION CRITERIA

- Pregnant patients and Patients not willing to undergo ultrasonography and fine needle aspiration cytology.

### RESULTS

Of the 40 patients in this study, females constituted 85% and males 15%. The age of the patient ranged from 15 years to 60 years.

**TABLE-1: ULTRASONOGRAPHIC DIAGNOSIS OF THE PRESENT CASES**

	Ultrasound diagnosis	No. of Patients	Percentage
1	Solitary nodule – total	11	27.5
	Adenomatous colloid nodule	7	17.5
	Follicular neoplasm	4	10
2	Multinodular goiter	13	32.5
3	Cystic lesions	2	5
4	Chronic thyroiditis	7	17.5
5	Grave's disease	2	5
6	Carcinoma of thyroid	5	12.5

**F.N.A.C.diagnosis :** Out of the 40 patients 38 underwent FNAC, 1 underwent FNAC of cervical lymphadenopathy along with FNAC of thyroid nodule and 2 suspected cases of Graves disease were not subjected to FNAC.

**TABLE – 2: FNAC DIAGNOSIS OF THE PRESENT STUDY**

	FNAC diagnosis	No. of Patients	Percentage
1	Colloid goiter		
	Solitary	6	15
	Multinodular	15	37.5
	Total	21	52.5
2	Follicular neoplasm	7	17.5
3	Benign cyst	-	-
4	Chronic thyroiditis		
	Hashimoto's	5	12.5
	Non specific thyroiditis	2	5
	Total	7	17.5
5	Papillary carcinoma	3	7.5

**TABLE – 3: COMPARISON BETWEEN ULTRASONOGRAPHIC & PATHOLOGICAL DIAGNOSIS**

	Disease	USG detected	Clinically detected	Pathological detected
1	MNG	13	13	15
2	Solitary nodule	11	18	13
3	Colloid nodule	7	-	6
4	Follicular neoplasm	4	-	7
5	Thyroid cyst	2	1	-
6	Chronic thyroiditis	7	4	7
7	Grave's disease (Toxic goiter)	2	3	-
8	Carcinoma	5	1	3

**TABLE –4 : EVALUATION OF THYROID DISEASES BY COLOR DOPPLER DUPLEX SONOGRAPHY**

		Sensitivity	Specificity	PPV
1	Detection of intra thyroid lesion by USG as compared to clinical examination	100%	100%	100%
2	Detection of benign lesion by USG as compared to cytology	90%	60%	81%
3	Detection of malignant lesions by USG as compared to cytology	90%	94.5%	60%
4	Detection of chronic thyroiditis by USG as compared to cytology	100%	100%	100%

## DISCUSSION

Due to superficial location of thyroid gland, high resolution real time gray scale and color duplex sonography can demonstrate normal thyroid anatomy and pathological conditions with remarkable clarity. This technique being non invasive, economical and without radiation hazards has come to the fore as an appropriate study in the diagnostic evaluation of thyroid diseases.

Color duplex sonography was performed with PHILIPS HD 11XE using linear probe 3-12 MHz frequency which provides excellent image details of thyroid anatomy and various pathological conditions of thyroid gland.

The study comprised of 40 patients between the age group 15 to 60 years. Of the 40 patients in this study, females constituted 85% and males 15%.

Out of 40 patients, we categorised 28 as solid, 2 as cystic and 10 as

mixed lesions.

## COLLOID GOITRE:

In our study, we found colloid goitres the commonest lesion with 21 cases out of 40 cases (52.5%). Almost 16 of these lesions were hyperechoic, 3 of the cases were isoechoic. 2 cases were cystic in nature. Nirad Mehta et al in 1993 found colloid goiter in 119 patients.<sup>5</sup>

## FOLLICULAR NEOPLASM:

In our study, 4 out of the 40 cases were found to be thyroid neoplasm. On ultrasound all these cases were hyperechoic. But pathologically detected cases were 7. Simeone et al found follicular adenoma in 79 (68%) out of 116 cases.<sup>6</sup>

## THYROID CYSTS:

In our study, we found 2 cases which were predominantly cystic in nature. Ultrasound guided fine needle aspiration biopsy was done in all 2 cases and showed that they were benign colloid goitres.

## THYROIDITIS:

In our study, we found 7 cases of chronic thyroiditis with 5 of them being Hashimoto's thyroiditis and 2 being non-specific. Erdogan ME, Anil C, Cesur M et al had found 24 cases of Hashimoto's thyroiditis while evaluating 55 patients with hyperthyroidism.<sup>7</sup>

## GRAVES DISEASE:

Our present study revealed 2 cases of Graves disease. Thyroid inferno type of vascular pattern was detected in them. Color Doppler sonography demonstrated a hypervascular pattern referred to as the "thyroid inferno". Spectral Doppler will demonstrate peak systolic velocities exceeding 70 cm/s which is the highest velocity found in thyroid disease. Erdogan ME, Anil C et al had studied 55 patients with hyperthyroidism. 29 patients were diagnosed as Graves disease.<sup>7</sup>

## THYROID MALIGNANCY:

Most of the primary thyroid cancers are epithelial in origin and most of them are well differentiated and Papillary carcinoma accounts for 75-90% of all cases. A C Nachiappan et al Features of malignancy include micro-calcifications, local invasion, lymph node metastases, a nodule that is taller than it is wide, and markedly reduced echogenicity. Other features, such as absence of halo, ill-defined irregular margins, solid composition, and vascularity are less specific but may be useful ancillary signs.<sup>8</sup>

In our study we detected only 2 cases of malignancy showing microcalcifications. 1 case of malignancy showed coarse calcification. combination of absent halo sign plus microcalcification plus intranodal flow pattern achieved a 97.2% specificity for the diagnosis of thyroid malignancy

## SUMMARY

A total of 40 patients were studied of which 34 patients (85%) were females and 6 patients (15%) were males. Age range varied from 15 years to 60 years. Most cases were in the age group of 21-30 years.

All patients underwent clinical examination at the earliest, followed by color duplex sonography of thyroid followed by FNAC. Ultrasonographic findings are correlated with FNAC findings.

Thyroid ultrasound was very efficient in picking up lesions in all 40 cases in our study. In comparison, to other studies our study gave a similar picture in terms of benign lesions being much more common than malignant lesions. The most common benign lesion determined in our study was adenomatous nodules which was the most common benign lesion in many other studies. (57.5%). In comparison to other studies, we were able to detect malignant nodules with a better

specificity. Chronic thyroiditis were also very efficiently detected using ultrasound in our study. Color Doppler was effectively used in our study to differentiate between Graves disease and Chronic thyroiditis which has similar gray scale finding.

**CONCLUSION**

1. Color assisted duplex sonography is a safe, fast, inexpensive, popular, cost-effective, repeatable, non-invasive procedure for investigating thyroid gland.

2. Color assisted duplex sonography is also a helpful guide for F.N.A.C./biopsy.

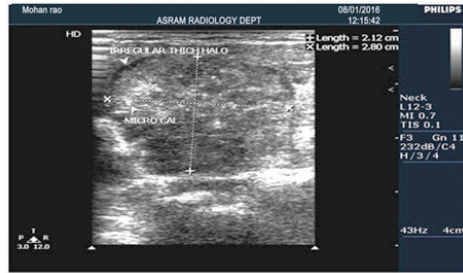
3. Color assisted duplex sonography also helps in accurate estimation of thyroid volume.

4. Because of the superficial location and good vascularisation of the thyroid gland, high resolution grayscale and color doppler sonography can demonstrate normal thyroid anatomy and pathological conditions with remarkable clarity.

5. Our experience demonstrates significantly improved sensitivity for high resolution ultrasound over other investigations for the anatomical characterization of thyroid lesions.

6. Ultrasound is valuable for identifying many malignant or potentially malignant thyroid nodules. Although there is some overlap between the ultrasound appearance of benign nodules and that of malignant nodules, certain features are helpful in differentiating between the two.

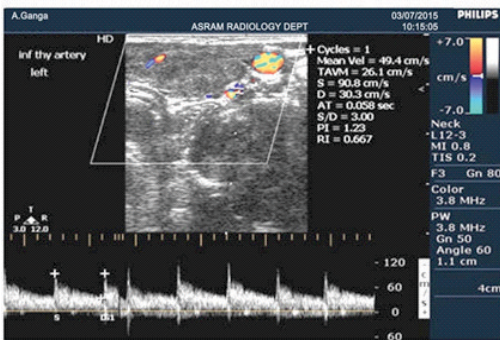
7. The newly developed high resolution ultrasonography with color doppler flow mapping function can reveal fine details of the thyroid gland and the haemodynamic features of thyroid neoplasms.



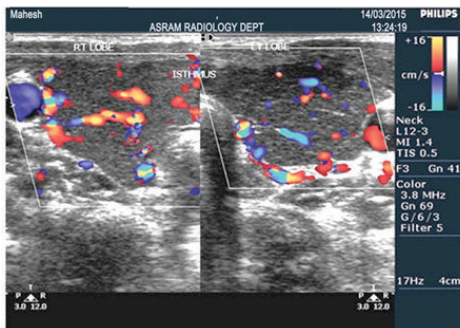
**FIG 3 : TRANSVERSE SCAN SHOWING WELL DEFINED HYPERECHOIC NODULE IN RIGHT LOBE OF THYROID WITH MICROCALCIFICATIONS AND THICK IRREGULAR HALO AROUND IT**

**REFERENCES**

1. Usha Menon, Sundaran JR: High prevalence of undetected thyroid disorders in iodine sufficient adult south indian population. Journal of Indian Medical Assoc, 2009 Feb; 107(2): 72-7.
2. Walker J, Findlay D et al : A prospective study of thyroid ultrasound scan in the clinically solitary thyroid nodule. British Journal Of Radiology 1985, 58(691): 617-619.
3. Taylor KJW, Carpenter DA et al : Gray scale ultrasonography in the diagnosis of thyroid swellings. Journal Of Clinical Ultrasound 2005; 2(4): 327-330.
4. Marquesee E, Benson CB et al : Ultrasonography in the management of thyroid nodules. Annals Of Internal Medicine 2000; 133(9): 696-700.
5. F Boi, M Loy et al : The usefulness of conventional and echo colour Doppler sonography in the differential diagnosis of toxic multinodular goitres. Euro J Endocrinol 2000 Sep; 143 (3) 339-46
6. Nirad Mehta et al : Sonographic appearance of solitary thyroid nodules, IJRA1994; volume 4:207-211.
7. Simeone JF et al : Sonography in follow up of 100 patients with thyroid carcinoma AJR 1987; 148:45 -49.
8. Erdogan MF, Anil C et al : Color flow Doppler sonography for the etiologic diagnosis of hyperthyroidism. Thyroid 2007 Mar; 17(3):223-8.
9. A C Nachiappan et al : The Thyroid : Review of imaging features and biopsy techniques with radiopathological correlation. Radiographics, march 2014, vol 34, issue 2, 276-29



**FIG 1: LONGITUDINAL SCANS SHOWING PERIPHERAL & INTERNAL VASCULARITY WITH THYROID INFERNOSUGGESTIVE OF GRAVES DISEASE**



**FIG 2: LONGITUDINAL SCAN SHOWING PERIPHERAL & INTERNAL VASCULARITY WITH MULTIPLE THIN SEPTATIONS SUGGESTIVE OF CHRONIC THYROIDITIS.**