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Thyroid Lesions: A Unique Approach

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Introduction

Thyroid lesions are a common finding in the general population, especially in iodine deficiency areas. With the more radical use of iodized salt and other measures the incidence of earlier common disorders like goiter, congenital hypothyroidism, etc. have dropped dramatically but still these are quite common in developing countries. Among the several imaging techniques that provide clinically useful anatomic information and pathologic condition about thyroid gland, sonography has become the method that is most commonly employed. Its use has resulted in early and accurate detection of various thyroid disorders. This is of immense help in timely management and prevention of complications. Colour Doppler Sonography is used in thyroid vascular study. Dynamic information such as velocity and direction of blood flow as well as degree of vascularity of organ can be revealed by colour doppler studies. Ultrasound vascular study is a noninvasive and low cost method

A study of thyroid lesion was done in 100 patients in leading teaching hospital, an attempt was made to evaluate and establish certain gray scale and colour Doppler criteria for distinguishing between benign and malignant thyroid lesions.

Aims & Objectives

1. Evaluation of common thyroid disorder in our setup.
2. To evaluate the accuracy of ultrasound in diagnosing thyroid disorders.
3. To evaluate the important sonological parameters in various thyroid disease.
4. To differentiate between solid, cystic and mixed nodular?
5. To differentiate between benign and malignant thyroid lesions.
6. To evaluate vascular nature of various thyroid lesion using colour Doppler.
7. Role of colour Doppler in distinguishing benign for malignant thyroid nodules.
8. Comparison of clinical, ultrasound colour Doppler and FNAC (fine needle aspiration cytology) findings.

Material and Methods

Patient selection & clinical presentation

Random selection of patient of all age groups was done. They presented with sign and symptoms suggestive of thyroid disorders.

The commonest clinical symptom was swelling in front of neck, which moves up with deglutition. There were systemic symptoms like pain and fever in thyroiditis weight loss and palpitation in hyperthyroidism, weight gain and hoarseness of voice in hypothyroidism and rapid increase in size with weight loss in malignancies. In nodular goiter, patients were usually thyroid. The nodules were palpable and sometimes visible.

The study was done from October 2013 to September 2014 in the Tertiary Hospital. 100 patients underwent sonography of the thyroid.

Technical consideration

- Colour Doppler ultrasound unit – Aloka Prosound alpha-6
- High frequency linear array ultrasound transducer with a range 8, 12, 14 MHz.
- Ultrasound jelly.

Linear array transducer were preferred to sector transducer because of wider near field of view and the capability to combine high frequency gray scale and Colour Doppler images.

Doppler settings were standardized to compare the vascularity of thyroid pathologies among different patients and to ensure intra individual consistency. Observations were recorded in the proforma and hard copy of imaging mode.

Technique of scanning

Patients were scanned in supine position. Visualization was enhanced by performing the examination with the neck hyper extended and by asking the patient to swallow so as to elevate the subclavicular portion of the gland. A small pad was placed under the shoulders to provide better exposure of the neck, particularly in patients with short stocky habitus. Scans were obtained in standard transverse and longitudinal as well as multiple oblique positions. Alteration in echogenicity and echo texture were noted and focal nodules were localized, measured and characterized. Examination was laterally extended to include the region of carotid artery and jugular vein to identify enlarged jugular chain of lymph nodes, superiorly to visualize submandibular adenopathy and inferiorly to define any pathological supraclavicular lymph nodes.

Observations

The findings in the study on 100 patients referred to the Department of Radio diagnosis are given below.

Statistical significance of sex ratio in thyroid disorders is depicted in Table 1

Sex	No. of Cases	Percentage
Male	17	17%
Female	83	83%
Total	100	100%

Table 1: *Sex ratio of thyroid disorders.*

The table shows that there were 83 females and 17 males of the total 100 cases. The male to female ratio in our study is 1:4.88. Patients were grouped into different age group according to their age, which is tabulated in Table 2

The age group studied included patients ranging from 75 years with youngest being female of 13 years and oldest male of 65 years. The major age group affected is between 20-40 years with 56 percentage cases.

Age	No. of Cases	Percentage
10-20	5	5%
20-30	23	23%
30-40	33	33%
40-50	18	18%
> 50	21	21%
Total	100	100%

Table 2: *Age Wise Distribution of the Cases.*

The pattern of involvement of thyroid gland in various thyroid disorders is depicted in Table 3.

Pattern of Involvement	No. of Cases	Percentage
Diffuse	20	20%
Nodular	80	80%
Total	100	100%

Table 3: *Pattern of Involvement of Thyroid Disorders.*

Thyroid disorders can either be diffuse or nodular. Thyroid disorders are predominantly nodular with ratio of diffuse to nodular being 1:4

The different sonographic criteria used to characterize diffuse thyroid disorders are classified in Table 4

Sonographic Criteria	No. of Cases N (20)	Percentage
Heterogeneity	15	75%
Micronodulations	3	15%

Table 4: *Sonographic Criteria in Diffuse Thyroid Diseases.*

Heterogeneous involvement of thyroid parenchyma was a feature of 15 (75%) patients. Fine 1-6 mm micro nodules were present in only 3 (27%) patients.

Thyroid nodules were categorized into three types on the basis of echotexture pattern, which is shown in Table 5.

Echotexture Pattern	No. of Cases	Percentage
Cystic	15	18.75%
Solid	41	51.25%
Mixed	24	30%
Total	80	100

Table 5: *Incidence of Different Echotexture Pattern in Thyroid Nodules.*

Out of total 80 thyroid nodules 18.75% were cystic, 51.25% were solid and 30% were mixed in echotexture.

Various B-Mode Criteria used in characterization of thyroid nodules are echogenecity, margins, halo and calcification. They are tabulated in Table 6.

B-Mode Findings	No. of Cases N-49	Percentage
Echogenecity		
Hypoechoic/Echofree	44	55%
Isoechoic	21	26.25%
Hyperechoic	15	18.75%
HALO		
Thin & Complete	64	80%
Thick & Incomplete	16	20%
MARGINS		
Regular	67	83.75%
Irregular	13	16.25%
Calcification		
Microcalcification	5	6.25%
Coarse Or Egg Shell	14	17.5%

Table 6: *Incidence of Different B-Mode Findings in Thyroid Nodules.*

Out of the total 80 nodules 21 were Isoechoic, 15 Hyperchoic and 44 Hypoechoic. 64 patients have thin and complete halo around the nodule whereas 16 patients has thick, incomplete or absent halo. Margins of the nodule were regular in 67 cases whereas it was Irregular in 13 cases.

All the patients' didnot show calcification. Only 5 patients have micro calcification whereas 14 patients have evidence of coarse of eggshell calcification.

Nodular vascularity was determined by power Doppler and classified into 5 types which are shown in Table 7.

Colour Doppler Pattern	No. of Cases	Percentage
Type I	18	22.5%
Type II	26	32.50%
Type III	34	42.50%
Type IV	2	2.5%
Total	80	100%

Table 7: *Colour Doppler Pattern in Thyroid Nodules.*

The Table shows that most of the patients have type II and III patterns Type I pattern in which there is only peripheral flow is seen in 18 (22.5%) nodules.

Type II pattern having peripheral and central component of flow with peripheral component predominating is seen in 26 (32.5%) patients. Type III pattern with central component predominating over the peripheral is seen in 34 (42.5%) patients. Only 2 patients have type IV pattern, which has only central flow.

Colour Doppler indices, which were taken into account in our study, were resistive index and peak systolic velocity. They are depicted in Table 8.

Colour Doppler Indices	No. of Cases N-49	Percentage
Resistive Index (RI)		
< 0.70	71	88.75%
> 0.70	9	11.25%

Table 8: *Colour Doppler Indices in Thyroid Nodules.*

Most of the thyroid nodules (88.75 %) have resistive indices less than 0.7 with only 11.25 % having RI over 0.7.

On the basis of different B-mode criteria diagnosis was assigned to the patient, which was then compared with FNAC (fine needle aspiration cytology). Sensitivity and specificity of each diagnosis was calculated which is shown in Table 9

Thyroid Pathologies	B-Mode	FNAC	False Positive	False Negative	Sensitivity	Specificity
Simple Goitre	11	12	-	1	92.3%	100%
Solitary Thyroid Nodule	15	14	3	2	85.7%	95.6%
Multinodular Goitre	43	40	3	-	100%	93%
Adenoma	15	14	4	5	73.6%	94.2%
Carcinoma	8	9	1	1	90%	98.6%
Hashimoto's Thyroiditis	4	5	-	1	80%	100%
Graves disease	4	6	-	2	75%	100%
Total	80	80	11	12	86.95%	-

Table 9: *Comparison of B-Mode Diagnosis with Fnac.*

Sensitivity of B-mode to diagnose malignancy is good (90 %). Among diffuse thyroid diseases B-mode was able to diagnose correctly all but one case of simple goiter and sensitivity for Hashimoto's thyroiditis was 80 %. B-mode under diagnosed 2 cases of Grave's disease. Overall sensitivity of B-mode in diagnosing thyroid pathologies is 86.95 %.

The incidence of different B-mode and colour Doppler findings in benign and malignant thyroid nodules were studied retrospectively, after the diagnosis was confirmed on FNAC. These different findings are depicted in Table 10

Ultrasound Findings	Benign		Malignant	
	N	%	N	%
Echogenecity				
Hypoechoic	38	47.5%	6	7.5%
Isoechoic	19	23.75%	2	2.5%
Hyperchoic	14	17.5%	1	1.25%
Halo				
Thin & Complete	62	77.5%	1	1.25%

Thick & Incomplete	9	11.25%	8	10%
Margins				
Regular	64	80%	2	2.5%
Irregular	7	8.75%	7	8.75%
Calcification				
Microcalcification	1	1.25%	4	5%
Coarse or Egg Shell	13	16.25%	1	1.25%
Colour Doppler Pattern				
Type I & II	42	52.5%	2	2.5%
Type III & IV	29	36.25%	7	8.75%
Resistive Index (RI)				
< 0.75	68	85%	1	1.25%
> 0.75	3	3.75%	8	10%

Table 10: *B-Mode & Colour Doppler Features in Benign & Malignant Thyroid Nodules.*

In our study most of the malignant lesions are hypo echoic with thick incomplete halo, irregular margins, micro calcification, resistive index > 0.70. Colour Doppler pattern type III & IV is 77.8 % sensitive and 59 % specific for malignancy.

Most of the benign lesions are isochoric or hyper echoic with thin complete peripheral halo, regular margins, coarse or eggshell calcification, resistive index < 0.70. Colour Doppler pattern type I & II is 59 % sensitive and 18.4 % specific for benign nodules.

The positive predictive value, negative predictive value and diagnostic accuracy of various gray scale and Doppler findings in differentiating malignant from benign lesions are shown in Table 11. The sensitivity and specificity of various gray scale and Doppler findings in differentiating malignant from benign lesions is depicted in the table below

	PPV	NPV	Diagnostic Accuracy
Absent Halo	47 %	98 %	87.5%
Irregular Margin	50 %	96.9%	88.75%
Micirocalcification	80%	92.8%	21.25%
RI > 0.7	72.7%	98.5%	95%
Colour Doppler Type Iii and Iv	19.4%	95.4%	61.25%

Table 11

Thus micro calcification and RI Of 0.7 has high specificity in prediction of malignant thyroid nodules

The specificity of type III and IV flow in detection of malignancy is low.

The effect on sensitivity when type of flow is combined with gray scale features is shown in Table 13

Thus we see that on combination of colour Doppler and gray scale parameters the specificity is increased.

	Carcinoma	Benign Nodules	Sensitivity	Specificity
Absent halo	8/9	9/71	88.8%	87.3%
Irregular Margin	7/9	7/71	77.7%	90%
Microcalcification	4/9	1/71	44.5%	98.5%
RI > 0.7	8/9	3/71	88.8%	95.7%
Type III &IV Flow	7/9	29/71	77.7%	59%

Table 12

	Carcinoma	Benign Nodules	Sensitivity	Specificity
Absent Halo +Type III &IV Alow	6/9	6/71	66.7%	91.5%
Irregular Margin +Type III & IV Flow	5/9	4/71	55.5%	94.36%

Table 13

Discussion

Thyroid diseases diagnosis requires a holistic approach. Although the thyroid is a superficial organ easily accessible to physical examination, it needs various biochemical and radiological investigations to confirm the diagnosis.

The introduction of high-resolution ultrasonography had made it possible to detect many non-palpable nodules in the thyroid. The incidence of such lesions in the general population appears to be high approximately 10-40%.

The present study was concluded in a tertiary hospital r from Oct. 2013-Sept 2014. The study population consisted of 100 patients who were diagnosed to have thyroid abnormality on ultrasonography.

In the present series, out of 100 patients, 83 were females and 17 were males. There is predominant involvement of thyroid gland in females with F: M ratio of 4.88:1.

Solbiati., *et al*. In their study of 401 patients found that 71.3% were females and 28.7% were males.

Khurana KK., *et al*. Reported their experience with 119 patients, out of which 100 (84%) were females and 19 (16%) males.

Summary and Conclusion

High resolution ultrasonography is highly sensitive in diagnosing thyroid disorders. Colour Doppler acts as an important adjunct to B-mode in increasing the accuracy.

In our study we concluded that -

- Females are more commonly affected than males.
- Most common age group affected is between 20-40 years.
- Nodular involvement of thyroid is more common than diffuse.
- Small hypo echoic 1-6 mm micro nodules are highly predictive of Hashimoto's thyroiditis
- Non-neoplastic nodules are more commonly hyper echoic or isoechoic whereas carcinomas are usually hypo echoic. Adenoma can present with variable echogenicity.
- Non-neoplastic nodules and adenomas usually present with regular margins whereas irregular margin is more a feature of carcinoma.

- Adenomas and non-neoplastic nodules are more commonly associated with thin and complete halo. Halo is thick, incomplete or absent in most of the carcinoma.
- Micro calcification has highest specificity for malignancy on B-mode.
- Coarse and eggshell calcification is highly predictive of benignity.
- Power Doppler pattern is not sensitivity and specific in differentiation of malignant and benign thyroid nodules in isolation.
- Resistive index < 0.70 in majority of non-neoplastic nodules. Carcinoma usually have RI > 0.70
- Specificity and positive predictive value of diagnosing a lesion as malignant increases, when combination of criteria is used, instead of individual criteria.

The goal of imaging should be to avoid extensive and costly evaluation in the most patients with benign disease without missing the minority of patients with thyroid cancer. High-resolution ultrasonography has proved high sensitivity in the detection of very small nodular lesions of the thyroid. Its specificity in definition of benign from malignant nature is being greatly improved by the new vascular pattern and resistive index parameters using pulsed and power Doppler. In this study we found no single criteria that could distinguish benign from malignant thyroid nodules with 100% reliability. FNAC (fine needle aspiration cytology) still offers the highest accuracy. Thyroid sonography is most useful in the differentiation between definitely benign nodules from suspicious which can then be subjected to further evaluation by FNAC (fine needle aspiration cytology).

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