International Journal of Research and Review
Vol.7; Issue: 1; January 2020
Website: www.ijrrjournal.com
Original Research Article *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

Ultrasonography of Thyroid Lesions with Clinicopathological Correlation

Nikita Jain[1], Parthiv Brahmbhatt[2], Chandra Ray Chaudhuri[3], Aman Singhal[4]

[1]Junior Resident 3rd Year, [2]Professor, [3]HOD,
Department of Radiology, Dhiraj Hospital, Waghodia Road, Piparia, Vadodara, Gujarat - 390019.
[4]Asst. Professor, Dept of Gen. Surgery, Dhiraj Hospital, Waghodia Road, Piparia, Vadodara, Gujarat - 390019.

Corresponding Author: Nikita Jain

ABSTRACT

Background: Thyroid gland is the most superficial endocrine gland of the human body in the region of neck and is easily accessible to both clinical and Radiological examinations. The thyroid abnormalities like thyroiditis, thyroid nodule, goiter and malignancy must be diagnosed and managed as early as possible. There are a number of diagnostic modalities available including conventional radiography, Ultrasonography (USG), Elastography, Computerized Tomography (CT), Magnetic Resonance Imaging (MRI), and Positron Emission Tomography (PET) scan.
Objectives: To evaluate the demographic profile of patient including age and gender distribution in thyroid lesions. Localization of clinically suspected thyroid nodule by high resolution Ultra-sonography and to differentiate solid from cystic masses, benign from malignant.
Method: The study had been carried out on 70 patients with clinically suspected thyroid disease referred to radiology department.
Results: In my study out of the 70 patients who had Thyroid diseases 78.5% were females and 21.4% were males. Maximum numbers of patients were between 41-50years of age, accounting for 35.7% of the cases. The most common complain noted was 'lump in the neck'. Maximum number of patients (72.8%) was Euthyroid. The most common pathology noted in the thyroid gland on sonography was Solitary Thyroid Nodule (43.75%). Diagnostic accuracy of high resolution sonography in thyroid diseases was Sensitivity 85.7% and Specificity 95%.
Conclusion: High resolution sonography is a useful modality for evaluation of thyroid diseases. It is reliable in distinguishing normal from abnormal thyroid. Thyroid sonography is useful in defining whether the patient has a diffuse abnormality, a multinodular pathology or a solitary nodule. High resolution sonography can differentiate benign from malignant thyroid nodules and masses in majority of cases. It is useful in diagnosis and follow up of diffuse thyroid diseases i.e. thyroiditis.

Keywords: Carcinoma, Follicular, Hashimotos, Papillary, Thyroiditis.

INTRODUCTION

The thyroid gland is the most superficial endocrine gland of the human body in the region of neck. It is easily accessible to both clinical and Radiological examinations. It plays a vital role not only in the regulation of various metabolic activities of our body but also has an important role in controlling the heart rate, cardiac output and skeletal growth. Thus, the thyroid abnormalities like thyroiditis, thyroid nodule, goiter and malignancy must be diagnosed and managed as early as possible.[1] Thyroid nodules are extremely common, found at palpation in 4% to 7% of an asymptomatic population,[2] in 17% to 27% of cases at USG, [3–5] and in 50% of cases at autopsy.[6]

It has been very fascinating and challenging for a clinical radiologist to evaluate the thyroid gland and diagnose the thyroid pathologies. As there are a number of diagnostic modalities available with varied sensitivity and specificity for thyroid gland. These include conventional

radiography, Ultrasonography (USG), Elastography, Computerized Tomography (CT), Magnetic Resonance Imaging (MRI), and Positron Emission Tomography (PET) together with nuclear studies.

The Plain X-ray has limited diagnostic role. However, a soft tissue swelling in the region of neck with or without tracheal compression or displacement with or without calcification in the region of thyroid could be a diagnostic clue for thyroid lesions.

Radionuclide imaging plays a key role in the evaluation of thyroid disease as it provides the excellent functional information about thyroid gland. The relative uptake of the radio-active isotope by using ^{99m}Technetium pertechnetateor ^{131}Iodine, to evaluate the focal thyroid nodule, gives the information as thyroid nodule as hot or cold.[1]

USG in a clinically suspected case of thyroid lesion has proved to be the most sensitive imaging modality in non-palpable nodules of 2-3 mm size. It allows a more accurate morphological characterization of the lesion including the size and the number, the volume of thyroid tissue and could well differentiate it from extra-thyroid neck masses. An addition of color and spectral Doppler imaging can determine the vascular pattern of lesion and has been found to be a very useful tool in screening the thyroid nodule for malignancy.[1]

CT can detect focal and diffuse thyroid abnormalities and incidental thyroid nodules (ITNs) and plays an important role in the evaluation of thyroid cancer. The thyroid gland may have variable Computed tomography (CT) scan findings such as single or multiple nodules, cysts, calcification or diffuse enlargement. On CT scans, a malignant lesion is suspected when the margins are ill-defined and there is extra-thyroid extension, lymph node involvement, or invasion of the surrounding structures but the absence of these features does not exclude malignant tumours, especially papillary, follicular, and medullary thyroid carcinomas [7]. Also the calcifications on a CT scan can be seen in benign as well as malignant thyroid lesions [7]. Hence, ultrasound is the investigation of choice for thyroid pathologies due to its superior spatial resolution compared to Computed tomography (CT Scan).

A Diffusion Weighted Imaging (DWI) on MRI, can well characterize and differentiate the benign from a malignant thyroid nodule of > 9 mm in size. It provides image contrast through measurement of the diffusion properties of water within tissues. DW-MRI provides advantage of evaluating local disease extension and metastatic spread owing to the superior anatomical detail offered by this modality. [10] But it is not cost effective and not available in every hospital.

USG Elastography is a dynamic technique and can provide an estimation of tissue stiffness by measuring the degree of distortion under the application of external force. But it has limited availability. It is used to differentiate malignant from benign lesions. USG Elastography has great potential as an adjunctive tool for the diagnosis of thyroid cancer especially in indeterminate nodules on cytology.[8]

F18-fluorodeoxyglucose-PET (^{18}F-FDG-PET) imaging can also be utilized in the evaluation of thyroid malignancies which are negative on iodine scintigraphy and FDG-PET positive, this is in contrast to indolent slow growing thyroid tumors which are iodine scintigraphy positive but FDG-PET negative. ^{18}F-FDG-PET has been found to be the most accurate method for detecting recurrent or metastatic medullary thyroid carcinoma (MTC) in patients with an elevated calcitonin level (tumor marker for MTC) postoperatively, when other radionuclide and cross-sectional imaging techniques fail to localize the tumor or metastatic disease. It is also superior to other imaging modalities in localizing cervical and mediastinal lymph node involvement. [1] But it produces radiation hazards and not widely available.

FNAC of the thyroid gland has radically changed the management of

patients with thyroid disease. FNAC is widely accepted as the most accurate, sensitive, specific, and cost-effective diagnostic procedure in the preoperative assessment of thyroid nodules.[12].

Thus, USG has proved to be the choice of imaging by the American Association of Clinical Endocrinologists (AACE), Society of Radiologist in Ultrasound, the American Thyroid Association, the European Thyroid Association and Associazione Medici Endocrinologi (AME) to confirm presence of a thyroid nodule, when physical examination is equivocal, and its characterization especially for differentiation between benignity and malignancy. It has a great advantage without radiation in differentiating the solid vs. cystic lesion and is excellent for guided biopsies without radiation hazard. [9]

This study is an attempt to evaluate the thyroid gland pathologies by USG imaging with clinic pathological correlation in patients coming to radio diagnosis department, Dhiraj Hospital, Pipariya, Vadodara in India.

AIMS AND OBJECTIVES

AIM

To evaluate the pathologies of thyroid gland by USG and its clinico-pathological correlation.

OBJECTIVES

1. To evaluate the demographic profile of patient including age and gender distribution in thyroid lesions.
2. Localization of clinically suspected thyroid nodule by high resolution Ultra-sonography and to differentiate solid from cystic masses.
3. Ultrasonographic and color Doppler evaluation of thyroid lesions to characterize them and to differentiate benign from malignant by correlating them with histopathology as and when required.
4. To define the spatial extent of these lesions and their relationship to the surrounding structures.

MATERIALS AND METHODS

VENUE

After the approval of the Dhiraj Hospital Research and Ethical Committee, this study was conducted on the patients referred from OPD/IPD of the Dhiraj Hospital, to the Department of Radiodiagnosis of SBKS Institute Of Medical Sciences, Vadodara, Gujarat.

TYPE OF STUDY: Observational study

SAMPLE SIZE: A minimum of 70 patients were included in the study.

SOURCE OF DATA:

The study was carried out on 70 patients referred from clinical departments and OPD of Dhiraj general Hospital, to the Department of Radio diagnosis of SBKS Institute Of Medical Sciences, Vadodara, Gujarat.

Each patient's age, gender, IPD/OPD number, address and contact number, together with Clinical features were recorded from the case sheet. Reports of haemogram, thyroid function tests were documented on proforma.

A written informed consent in patent's native language was taken.

Cases were selected consequently with following inclusion and exclusion criteria.

INCLUSION CRITERIA:

1. Willing patients who gave written consent were included in this study.
2. All the cases referred on clinical grounds for suspicion of thyroid disease with or without deranged thyroid function tests were taken.
3. Patients with a palpable thyroid swelling or nodule.

EXCLUSION CRITERIA:

1. All patients with previous FNAC or biopsy proven diagnosis.
2. Patients who had previously undergone thyroid surgery for any reason.
3. Patients not willing to participate.

OBSERVATIONS & RESULTS

The present study was done on total Seventy (70) consented patients, referred for the USG evaluation of suspected thyroid disease to the Department of Radio-diagnosis and Imaging from OPD/IPD of clinical departments at Dhiraj Hospital, Waghodia Road, Piparia, Vadodara (Gujarat).

After meeting inclusion criteria, a total seventy (70) patients of both sexes and different age group, were included in the present prospective study. These patients clinical and relevant blood investigations data was recorded and high resolution USG examination of neck was done for evaluation of thyroid gland. Further patients were also subjected for either direct or guided FNAC, as the case required. The clinical data, USG and FNAC findings were recorded, compared and analyzed to achieve the aims and objectives. The data collected was subjected to statistical analysis and results derived.

The observations are presented as follows:

DEMOGRAPHIC PROFILE OF PATIENTS:

TABLE 1: GENDER WISE DISTRIBUTION OF PATIENTS: *n*=70

GENDER	NUMBER OF PATIENTS	PERCENTAGE
MALE	15	21.4
FEMALE	55	78.5
TOTAL	70	100

TABLE 2: AGE AND GENDER DISTRIBUTION OF PATIENTS WITH THYROID DISEASES DETECTED BY SONOGRAPHY: *n*=70

AGE GROUP	Male	%	Female	%	Total	%
11-20 Years	1	1.4	4	5.7	5	7.1
21-30 Years	3	4.2	10	14.2	13	18.5
31-40 Years	2	2.8	13	18.5	15	21.4
41-50 years	3	4.2	22	31.4	25	35.7
51-60 Years	2	2.8	3	4.2	5	7.1
61-70 Years	3	4.2	2	2.8	5	7.1
>70 Years	1	1.4	1	1.4	2	2.8
Total	15	21.4	55	78.5	70	100

CLINICO – PATHOLOGICAL CORRELATION:

The clinical diagnosis of solitary thyroid nodule was correlated with high resolution USG findings.

TABLE 3: DISTRIBUTION OF PATIENTS BASED ON THYROID FUNCTION TEST: *n*=70

THYROID STATUS	Number of Patients	Percentage
Euthyroid	51	72.8
Hypothyroid	12	17.14
Hyperthyroid	7	10

The clinical diagnosis of solitary thyroid nodule was correlated with high resolution sonography findings.

TABLE 4: CLINICAL VERSUS HIGH RESOLUTION SONOGRAPHY IN DETECTION OF THYROID NODULARITY *n*=48

NODULARITY	NO. OFCASES	PERCENTAGE
CLINICAL STN	48	68.57
SONOGRAPHIC STN	21	43.75
MNG	17	35.4
ABSENCE OF NODULES	10	20.85

ULTRASONOGRAPHIC FINDINGS OF THYROID NODULES:

The USG features of Thyroid Nodules presenting as STN are given below:

TABLE 5: DISTRIBUTION ON THE BASIS OF LOCATION OF THE NODULES: *n*=21

LOCATION	NO. OF CASES	PERCENTAGE
RIGHT	11	52.3
LEFT	8	38
ISTHMUS	2	9.7

TABLE 6: SONOGRAPHIC FEATURES OF THYROID NODULES PRESENTING AS STN: *n*=21

USG FEATURES OF STN	NO. OF CASES	PERCENTAGE
	21	
ECHOPATTERN		
Isoechoic	16	76.4
Heteroechoic	3	14.2
Hyperechoic	2	9.5
CONSISTENCY		
Solid	6	28.5
Mixed	12	57
Predominantly cystic	3	14.2
CALCIFICATION		
Coarse	6	28.5
Micro calcification	0	0
Comet tail	3	14.2
HALO		
Complete, thin, well defined	18	85.7
Incomplete	3	14.3
MARGINS		
Well defined	21	100
Ill defined	0	0
VASCULARITY		
Peripheral	15	71.4
Intra nodular and peripheral	6	28.5

Details of sonographic features in cases of non toxic multinodular goiter:

TABLE 7: SONOGRAPHIC FEATURES OF PATIENTS WITH MULTINODULAR GOITRE: *n*=17

USG FEATURES OF MNG	NO. OF CASES	PERCENTAGE
	17	
ECHOPATTERN		
Isoechoic	9	52.9
Heteroechoic	6	35.5
Hyperechoic	2	11.7
CONSISTENCY		
Solid	4	23.5
Mixed	12	70.5
Predominantly cystic	1	6
CALCIFICATION		
Coarse	5	29.4
Micro calcification	0	0
Comet tail	0	0
HALO		
Complete, thin, well defined	15	88.3
Incomplete	0	0
Absent	2	11.7
MARGINS		
Well defined	17	100
Ill defined	0	0
VASCULARITY		
Peripheral	14	82.6
Intra nodular and peripheral	3	17.6

THYROIDITIS

USG appearance of the thyroid in cases of Thyroiditis are tabulated below

TABLE 8: SONOGRAPHIC FEATURES IN PATIENTS WITH THYROIDITIS. *n*=19

USG FEATURE	NO. OF CASES	PERCENTAGE
ECHOPATTERN		
Hypoechoic	17	89.4
Isoechoic	0	0
Hyperechoic	0	0
Heteroechoic	2	10.6
Cystic degeneration	0	0
Calcification	0	0
Nodularity	2	10.6
Atrophic parenchyma	1	5.3

The incidence of various thyroiditis as seen at pathology is summarized below:

TABLE 9: DISTRIBUTION OF CASES AS FOUND AT PATHOLOGIC EXAMINATION, SUSPECTED TO BE THYROIDITIS ON USG. *n*=19

Pathology	No. Of Cases	Percentage
Hashimotos Thyroiditis	4	21.05
Lymphocytic Thyroiditis	15	78.94

TABLE 10: DISTRIBUTION OF THYROID NEOPLASM AS FOUND AT PATHOLOGIC EXAMINATION. n=13

Sr. No	Pathology	No. of cases			Percentage
1.	Thyroid adenoma	M	F	M+F	100
		0	6	6	
2.	Malignant lesions			7	100
	Papillary	0	4	04	57.1%
	Follicular	1	1	02	28.5%
	Medullary	0	0	00	0
	Anaplastic	1	0	01	14.2%
	Metastasis	0	0	00	0
	Lymphoma	0	0	00	0

Table 11: Sonographic Features of thyroid Neoplasms

Sr. no		Usg features	Adenoma n =6	%	P P Ca n=4 n=4	F Ca n=2	M ca n= 0	A ca n=1	Mets n=0	Lymphoma n=0	%
1	Consistency	solid	5	83.3	1	2	0	1	0	0	57.1
		Mixed	1	16.6	0	0	0	0	0	0	0
		Predominantly cystic	0	0	3	0	0	0	0	0	42.8
2	Echopattern	Hypoechoic	0	0	2	2	0	1	0	0	71.4
		Isoechoic	1	16.6	0	0	0	0	0	0	0
		Hyperechoic	3	50	0	0	0	0	0	0	0
		Heteroechoic	2	33.3	2	0	0	0	0	0	28.5
3	Halo	Thin, complete, well defined	4	66.6	1	0	0	0	0	0	14.2
		irregular/ incomplete/ thick/ absent.	2	33.3	3	2	0	1	0	0	85.7
4	Calcification	coarse	0	0	0	0	0	0	0	0	0
		Micro calcification	2	33.3	3	0	0	1	0	0	57.1
		Rim calcification	0	0	0	0	0	0	0	0	0
		No calcification	4	66.6	1	2	0	0	0	0	42.8
5	Margins	welldefined	4	66.6	1	0	0	0	0	0	14.2
		Illdefined/ Irregular	2	33.3	3	2	0	1	0	0	85.7
6	Extra thyroid involvement	Nodes	2	33.3	4	2	0	1	0	0	100
		Muscle invasion	0	0	0	0	0	0	0	0	0
		Tracheal Infiltration	0	0	0	0	0	0	0	0	0
		Vessel infiltartion	0	0	0	0	0	1	0	0	14.2

P = Papillary, F= Follicular , M= Medullary, A= Anaplastic.

Table 12: Colour Doppler findings in thyroid neoplasms.

Sr.no	Pathology	Color Flow Imaging	
		Predominant Peri lesional	Intra and Peri lesional
1.	Thyroid adenoma	6	2
2.	Malignant Papillary CA	0	4
	Follicular CA	0	2
	Anaplastic	0	1

TABLE 13: COMPARISON OF USG CHARACTERSTICS OF VARIOUS DISEASES: n=70

Since the following diseases were more commonly encountered in our study, we did a comparison of their various ultrasonographic features.

	STN	MNG	THYROIDITIS	NEOPLASM	
				BENIGN	MALIGNANT
Total Cases	21	17	19	6	7
CONSISTENCY					
Solid	6	4	0	5	4
Solid-Cystic	12	12	0	1	0
Cystic	3	1	0	0	3
ECHOPATTERN					
Hypoechoic	0	0	17	0	5
Isoechoic	16	9	0	1	0
Hetroechoic	3	6	2	2	2
Hyperechoic	2	2	0	3	0
Anechoic	0	0	0	0	0
CALCIFICATION					
Coarse	6	5	0	0	0
Microcalcification	0	0	0	2	4
Rim calcification	0	0	0	0	0
Comet Tail	3	0	0	0	0
HALO					
Thin, regular, complete	18	15	0	4	1
Thick, incomplete, rregular	3	0	0	2	6
Absent	0	2	0	0	0
MARGINS					
Well defined	21	17	0	4	1
Ill defined	0	0	0	2	6
VASCULARITY					
Peripheral	15	14	0	6	0
Avascular	0	0	0	0	0
Intranodular and Peripheral	6	3	0	2	7
RETROSTERNAL EXTENSION	0	0	0	0	0
NODAL EXTENSION	0	0	0	2	7

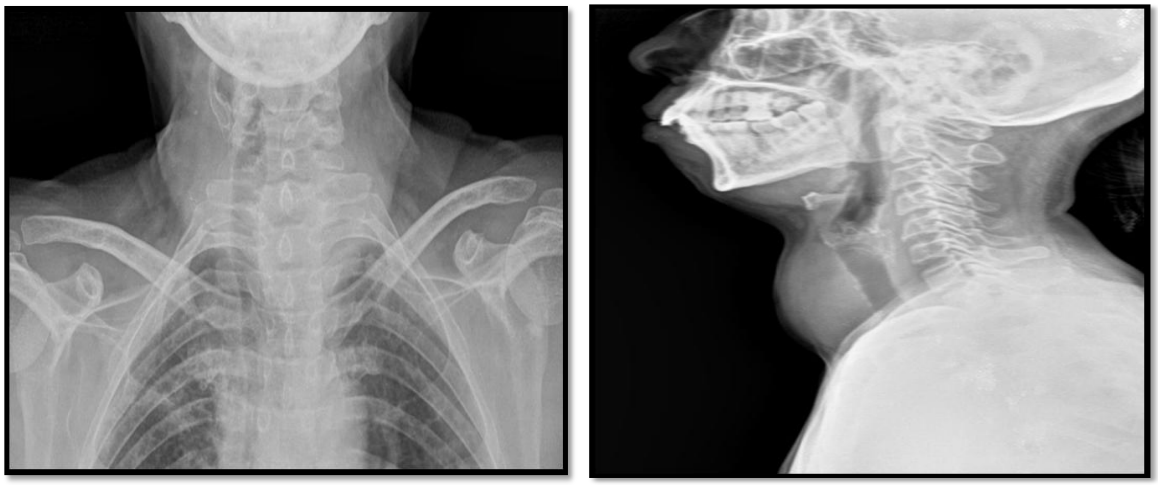


Image no 1 & 2: Enlarged Thyroid Gland: X-ray Soft Tissue Neck AP and Lateral view- 1) AP view shows a soft tissue mass in the neck causing displacement of trachea on right side. 2) Lateral view -Soft tissue mass in the neck. No Retro tracheal extension of the mass was noted in lateral view.

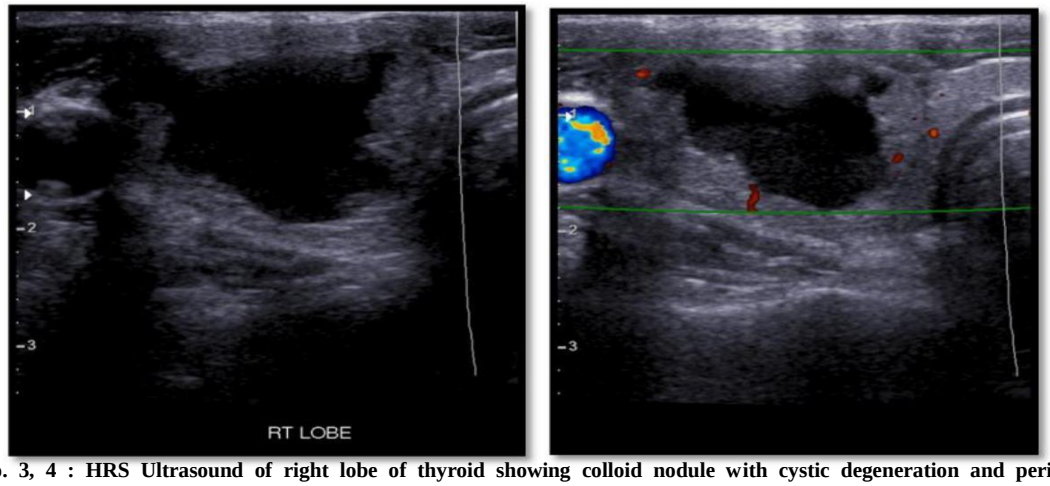


Image No. 3, 4 : HRS Ultrasound of right lobe of thyroid showing colloid nodule with cystic degeneration and peripheral vascularity.

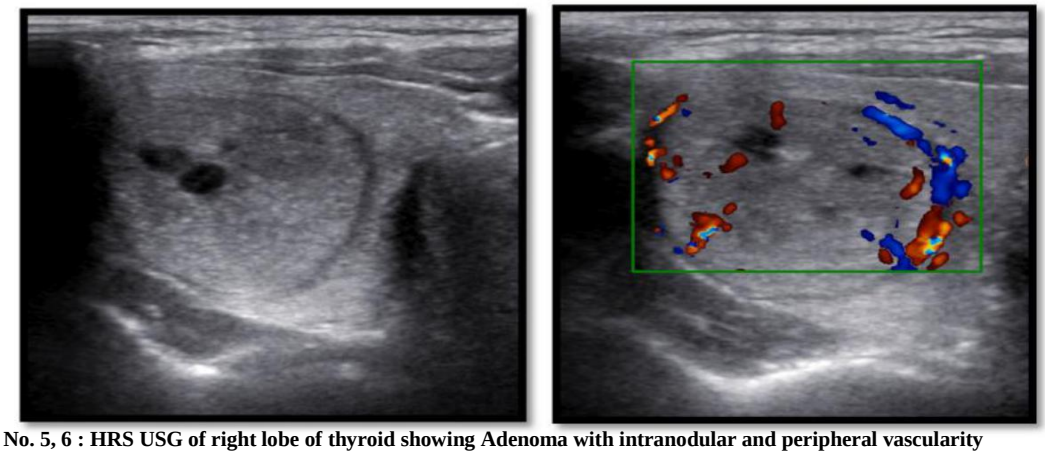


Image No. 5, 6 : HRS USG of right lobe of thyroid showing Adenoma with intranodular and peripheral vascularity

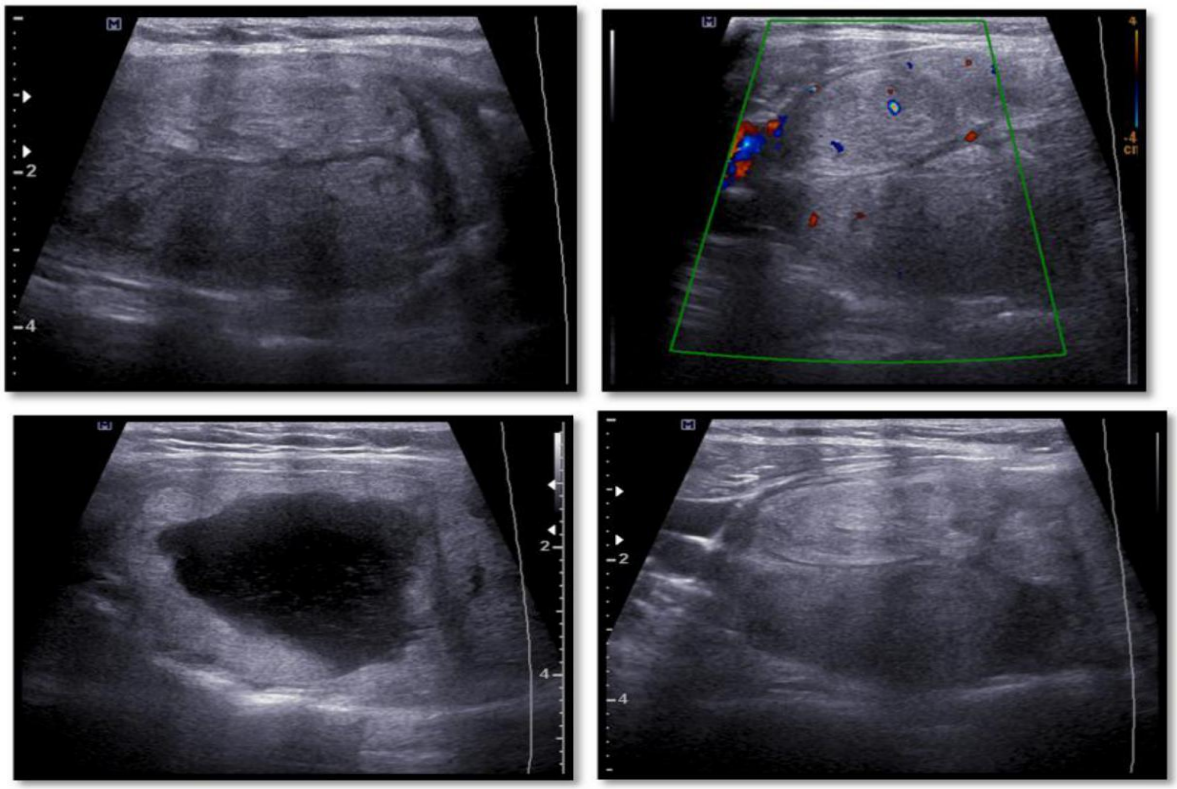


Image No. 7-10 : HRS USG a patient with multinodular goiter showing multiple well defined solid and cystic nodules with thin, hypoechoic halo around and internodular vascularity.

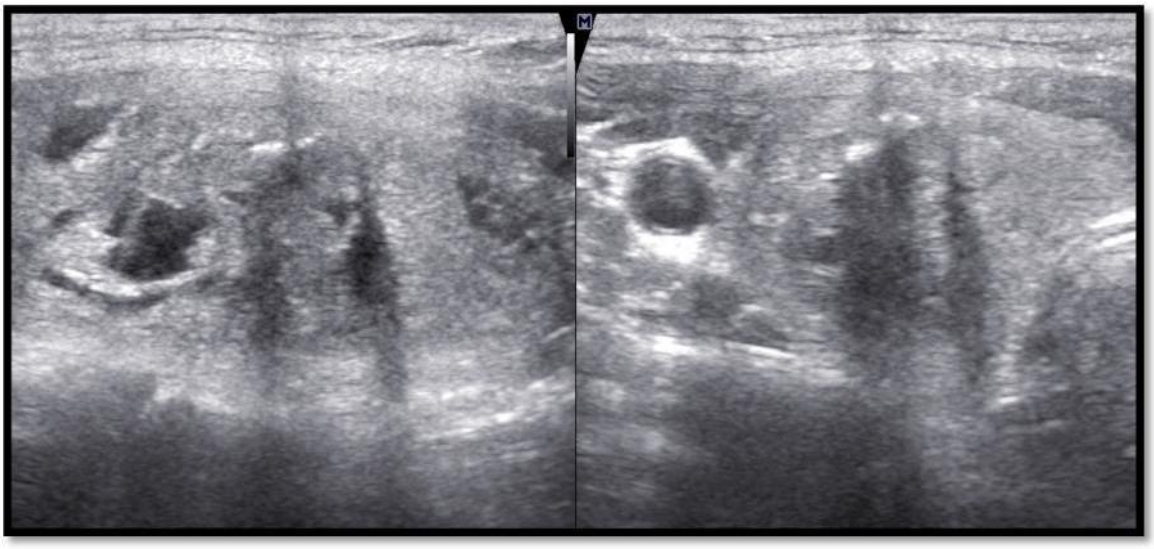


Image No. 11,12 : HRS grey scale USG showing coarse calcifications in nodule of the right lobe of thyroid gland

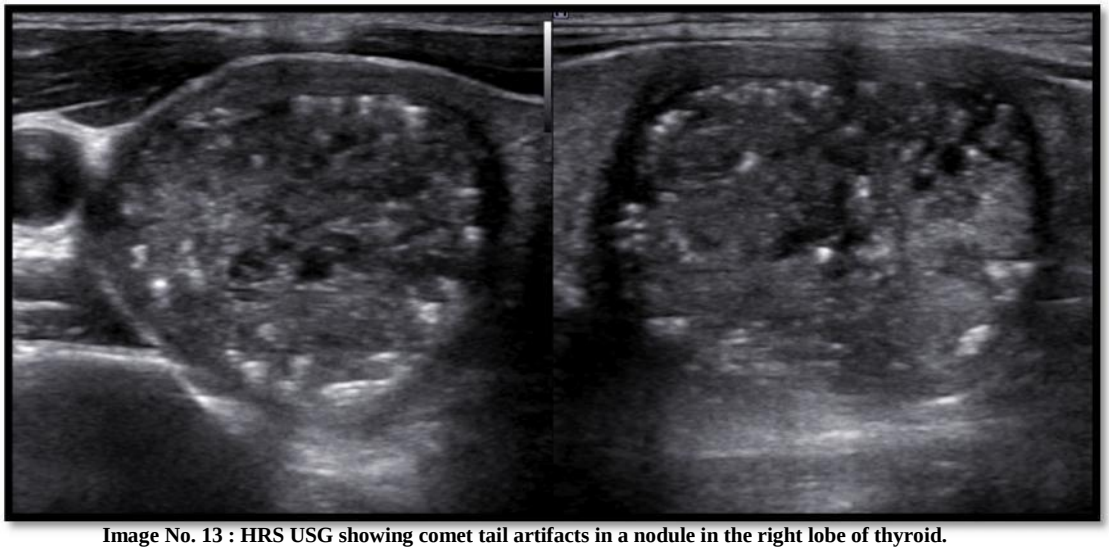


Image No. 13 : HRS USG showing comet tail artifacts in a nodule in the right lobe of thyroid.

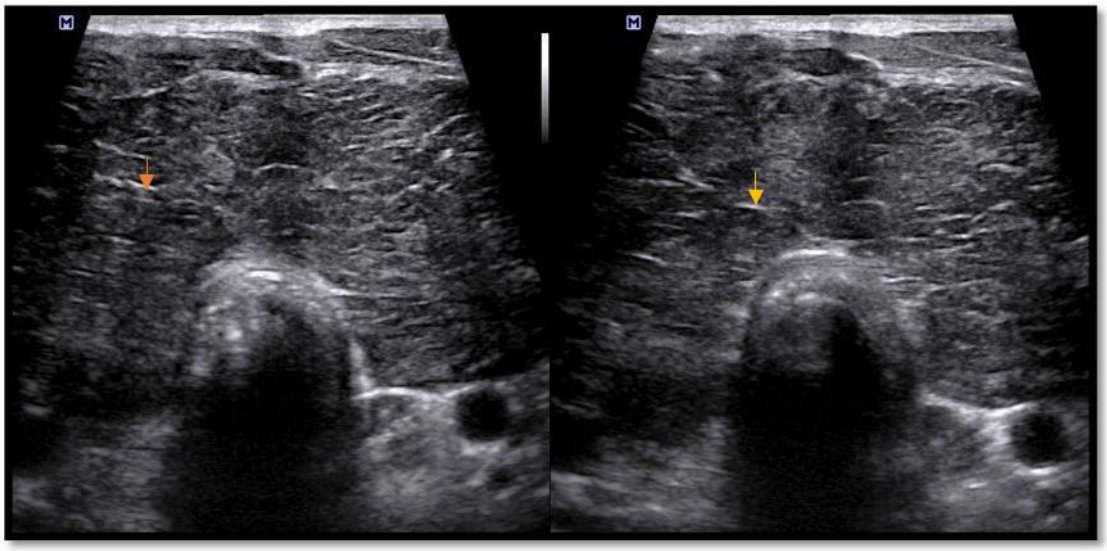


Image No. 14: HRS USG showing a diffusely enlarged, hypoechoic thyroid gland with linear echogenic fibrous septae, FNAC showed features of Hashimotos thyroiditis.

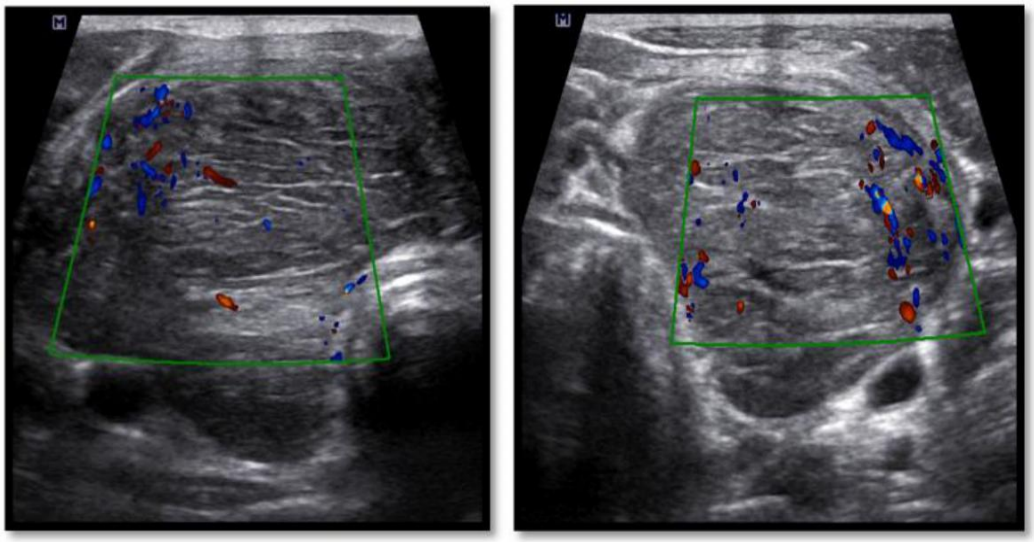
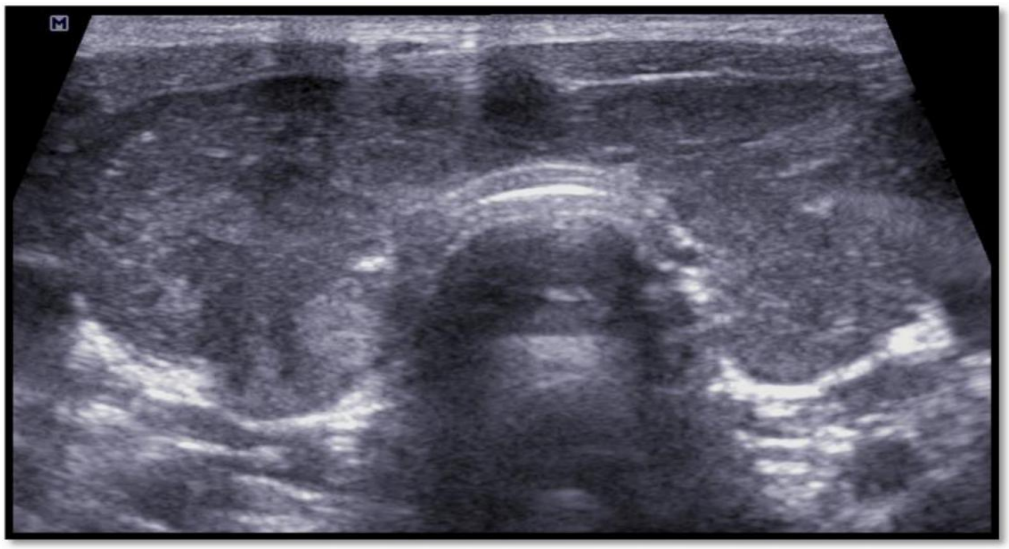


Image No. 15,16: Color Doppler in the same patient showed reduced parenchymal vascularity, FNAC showed features of Hashimotos thyroiditis.



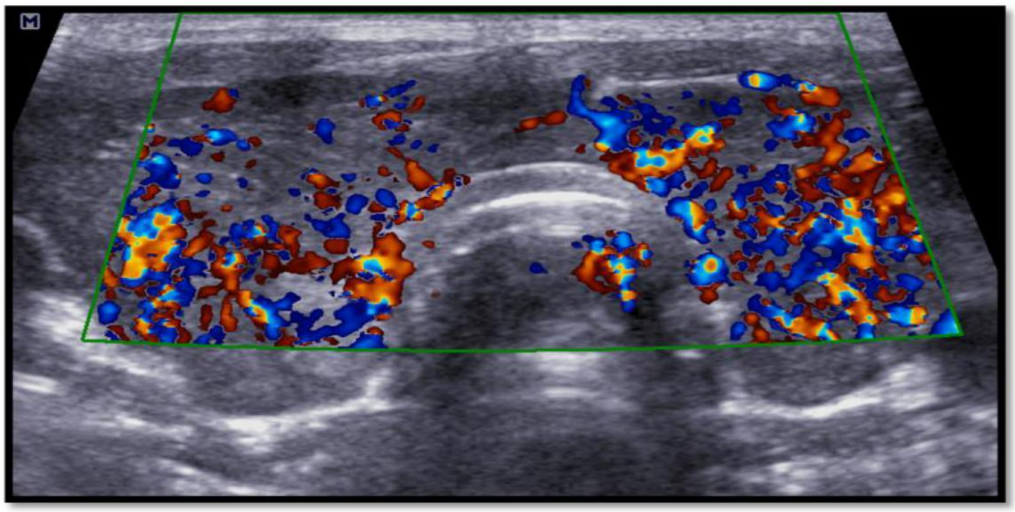


Image No. 17,18 : HRS USG showing in a patient of Grave's disease the diffusely enlarged, hypoechoic thyroid gland with diffusely increased vascularity on Color Doppler

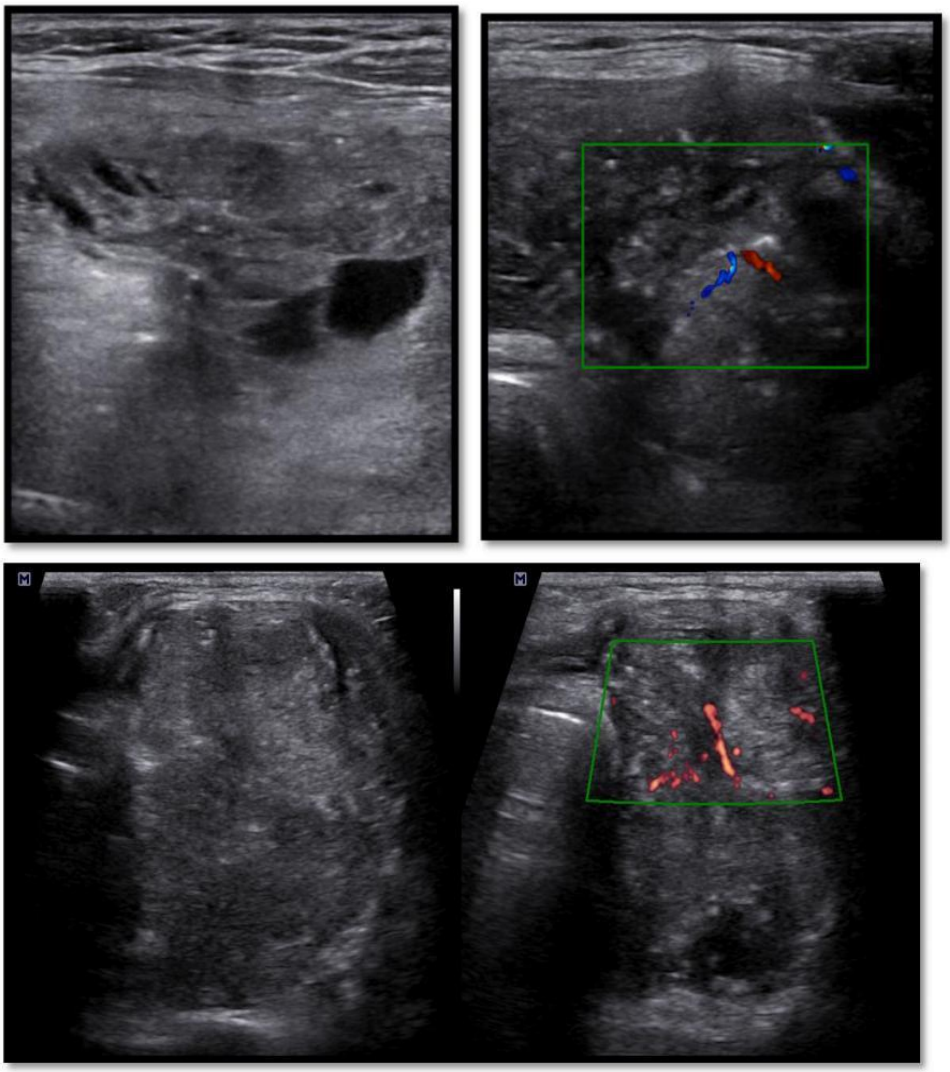
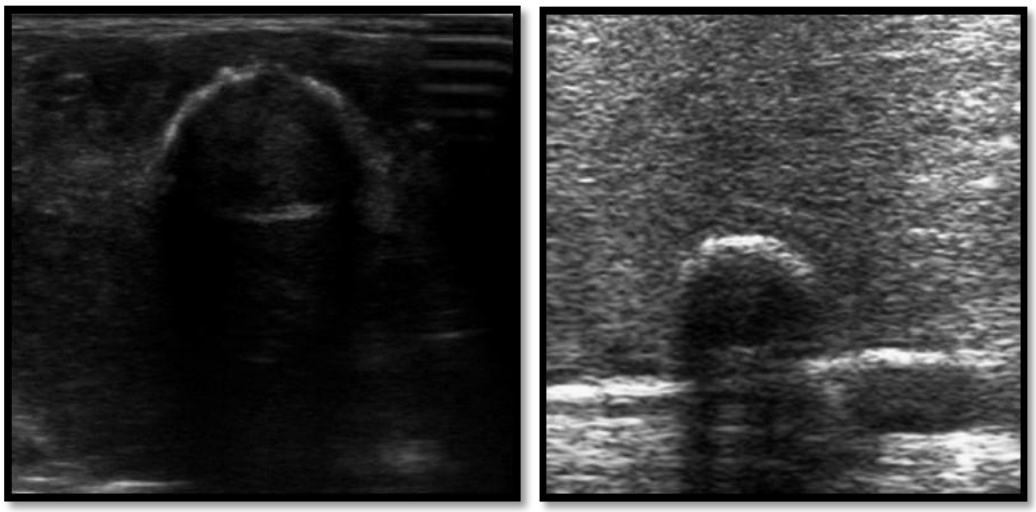


Image No. 19-22 : HRS USG in a 92 year old female showing relatively hypoechoic nodules with ill defined margins in the left lobe of thyroid with absent halo and multiple microcalcifications. Color Doppler revealed predominant internal vascularity. FNAC showed features of Papillary carcinoma.



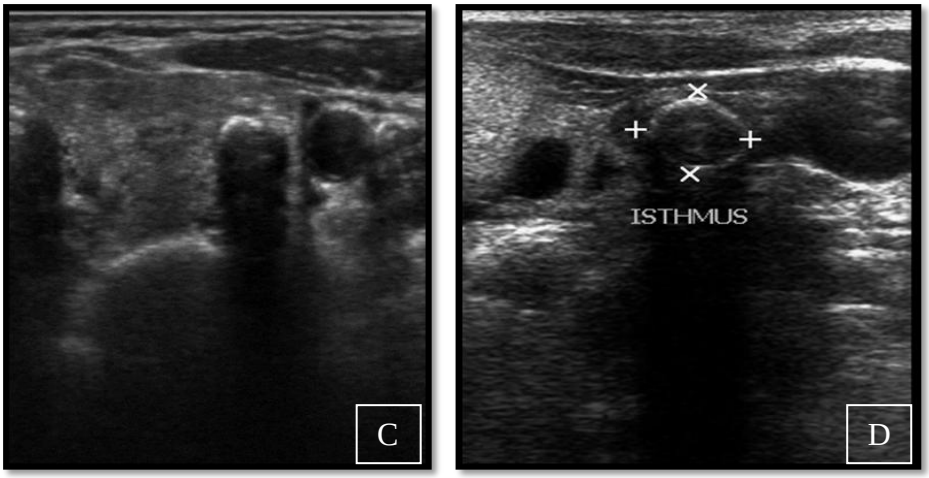


Image 23-26: Egg Shell Calcification : peripheral (egg shell) calcification was previously thought to indicate a benign nodule , but malignant nodules may have the appearance shown in these images , A. Coarse peripheral calcification casting a large acoustic shadow ; B,C. Peripheral egg shell calcification ; D. hypoechoeic mass caused by papillary carcinoma surrounds area of egg shell calcification.

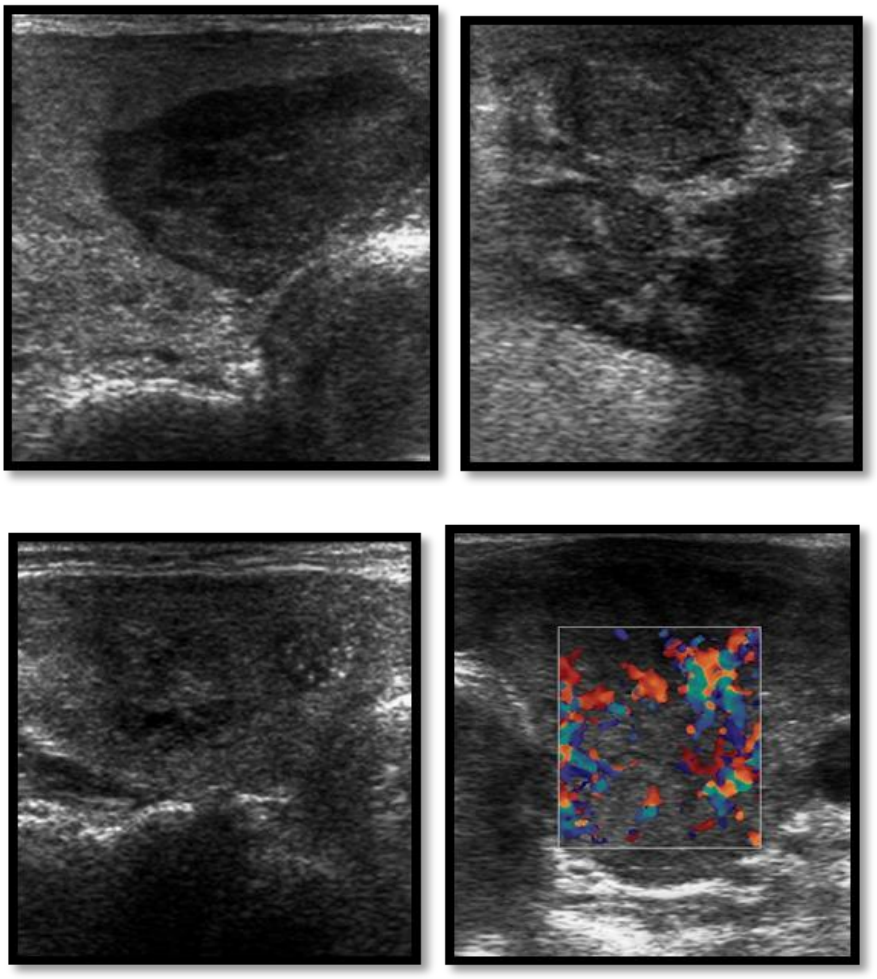


Image no 27-30:
Papillary Thyroid Carcinoma : Spectrum of appearances A. Transverse image demonstrate an irregular extremely hypoechoeic solid nodule without evidence of calcification or peripheral halo ; B. Longitudinal and; C. Transverse images show hypoechoeic nodules that has echogenic foci caused by mircocalcification ; D. On colour Doppler analysis nodule typically shows predominantly internal vascularity.

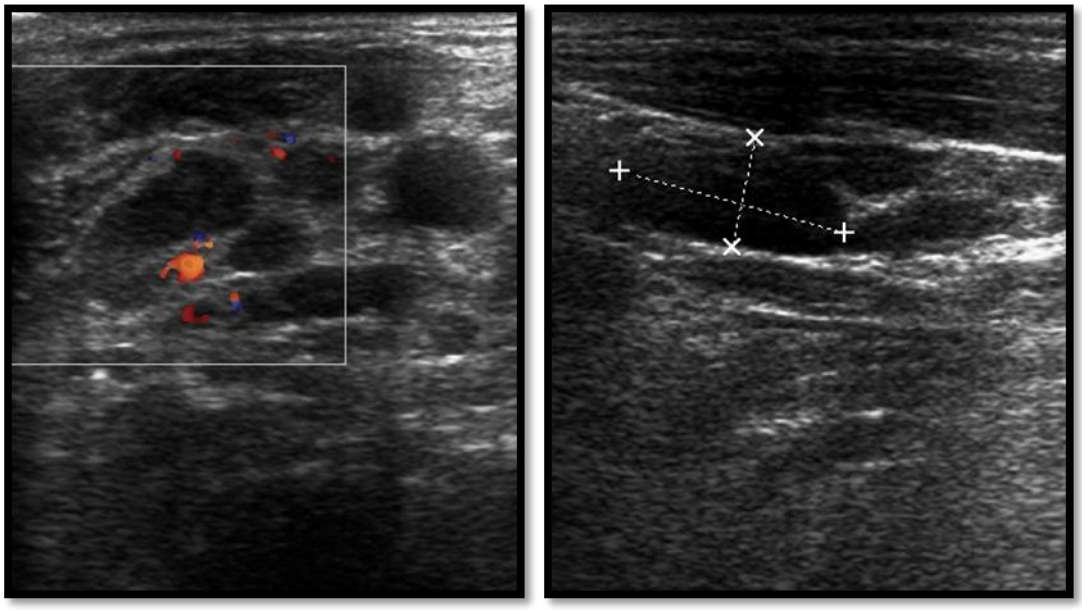


Image No 31 & 32:
Metastasis involving cervical lymph nodes : Spectrum of appearances
A.multiple small round to oval hypoechoeic lymphnodes , despite their small size the round shape and hypoechoeic patterns are highly indicative of metastasis ; B. Showing a lymphnode with cystic change . Cystic change in cervical lymphnodes is almost always caused by metastatic papillary carcinoma

DISCUSSION

DIAGNOSTIC ACCURACY OF HIGH RESOLUTION SONOGRAPHY IN THYROID DISEASES.

- High resolution sonography could correctly distinguish between normal and abnormal thyroid in all cases.
- Accuracy of high resolution sonography in distinguishing malignant from benign thyroid lesions was calculated as follows :-

True Positive (TP): Malignancy diagnosed by sonography and at pathologic examination (6)
True Negative (TN): Malignancy excluded by sonography and at pathologic examination (38)
False Positive (FP): Malignancy diagnosed by USG and not found on pathologic examination (2).
False Negative (FN): Malignancy excluded by sonography and pathology revealing malignancy (1)

$$\text{Sensitivity: } \frac{TP}{TP+FN}\times 100=\frac{6}{7}\times 100=85.7\%$$

$$\text{Specificity: } \frac{TN}{TN+FP}\times 100=\frac{38}{40}\times 100=95\%$$

$$\text{Positive predictive value: } \frac{TP}{TP+FP}\times 100 = \frac{6}{8}\times 100=75\%$$

$$\text{Negative predictive value: } \frac{TN}{TN+FN}\times 100 = \frac{38}{39}\times 100=97.4\%$$

High resolution Ultra-sonography is generally the first choice for evaluation of thyroid diseases. It demonstrates thyroid morphology with remarkable clarity due its superficial location in the neck. It has been used to distinguish normal from abnormal thyroid and to classify the abnormality as diffuse or focal. Ultra-Sonography has also been used to characterize the morphology of the lesion and suggest a pathologic diagnosis.

The present study was undertaken to evaluate the role of High Resolution Ultra-Sonography in evaluation of thyroid diseases. A total of 70 patients of either sex,

referred to the Department of Radio-diagnosis, Dhiraj general hospital, Vadodara, were evaluated. Pathological correlation was obtained in all the cases to evaluate the diagnostic accuracy of High Resolution Ultra-Sonography.

The youngest patient in our study was 14 years old and the oldest 80 years old. The largest group of patients were in the 41-50 year age group. There were only two patient above 70 years old and five patients below 20 years of age. The mean age was 42.2 years.

A female preponderance was noted in patients with thyroid disease in all age groups except between 61-70 years where there were more males then females. 78.5% of the patients were females and 21.4% were males. The overall sex ratio was M:F = 1:3.6. A similar female preponderance was noted by Solbiati et al[16] in 1985 and Nam Goong et al [25] in 2003 in their respective studies.

In the present study there was a higher incidence of all thyroid diseases in females. Solbiati et al [16] observed in their study that there was a higher incidence of both benign and malignant diseases in females.

In our study 51 (72.8%) out of the 70 patients were euthyroid. 12 (17.14%) of them were hypothyroid and 7 (10%) were hyperthyroid.

Out of 48 patients with clinical suspicion of thyroid nodule, 35.4% of patients diagnosed as Solitary Thyroid Nodule clinically were found to have a multinodular thyroid disease at high resolution sonography. 21(43.75%) patients were sonographically proven to be STN. 10 patients who clinically suspected to be STN were diagnosed as other thyroid disorders and showed no evidence of nodularity on Ultra-sonography.

HYPERPLASTIC GOITRE

The commonest thyroid pathology encountered in the study was hyperplastic goiter (54.2%).

A variable incidence of thyroid pathologies has been reported in literature. Solbiati et al[16] in 1992 reported hyperplasia of thyroid as the commonest thyroid pathology.

Simeone et al[22,23] , 1982 reported follicular adenoma as the commonest thyroid pathology.

Of the 38 patients with hyperplastic goiter, 21 patients had solitary thyroid nodule while 17 had multinodular goiter. Variable consistency of thyroid lesions was noted in the above group, the majority of patients having mixed lesions i.e. both solid and cystic. In patients with STN, consistency of 57% nodules was mixed solid- cystic, followed by solid nodules in 28.5%. Only 14.2% of STN cases were predominantly cystic in consistency. 70.5% of the MNG were solid- cystic in consistency, followed by purely solid consistency in 23.5% cases.

A variable echopattern was noted with majority of lesions being isoechoic. Majority of the patients with nodular goiter showed isoechoic lesions with areas of cystic degeneration. Similar patterns of consistency and echopattern were observed by Blum et al [18-21] 1975, Scheible et al[17] 1978, Solbiati et al[16] 1992 in their respective study groups.

Coarse calcification was seen in 15.7% of cases of hyperplastic goiter. Microcalcification was not observed in any case of hyperplastic goiter.

A thin well defined and complete halo was seen in 85% of patients presenting as sonographic STN and 88% of multinodular goiter. 12% of the patients with multinodular goiter did not show any perinodular halo. 15% of patients with sonographic STN had incomplete halo.

Similar gray scale findings have been reported by various authors i.e. Austin 1982 [27], Simeone et al [22,23], 1982, Hayashi et al[24], 1985 and Solbiati 1992[16].

Color Doppler study in cases of USG STN revealed 71.4% of the nodules to have peripheral flow only while 28.5% of the nodules had both intranodular and peripheral flow.

In patients with multinodular goiter, on color Doppler study, 82.6% of the nodules showed mild velocity internodular flow. 17.6% nodules had both intranodular and peripheral flow.

THYROIDITIS

There were 19 cases of thyroiditis in the study. All the cases had solid thyroid parenchyma. 17 (89.4%) cases showed diffusely hypoechoic thyroid gland with echogenic septations and 2 (10.6%) cases showed hetroechoic echotexture. Calcification was not seen in any of the cases. Most of the patients showed reactive cervical lymphadenopathy. One patient of thyroiditis had markedly reduced thyroid volume suggestive of atrophic thyroiditis. Color Doppler study was done in all the cases. It revealed diffuse parenchymal flow of low to medium velocity in all the patients.

Similar gray scale findings have been reported in thyroiditis by Blum et al 1977 [18-21], Simeone et al 1982 [22,23], and Solbiati et al 1992[16]. The color Doppler findings are consistent with those of Ralls et al 1988 [28] and Clark et al 1995 [26].

There were two patients with nodular Hashimotos thyroiditis. Both patients showed multiple hyperechoic nodules in a background of diffusely altered parenchyma. These nodules were ill defined in one patient while well-defined hyperechoic nodules with hypoechoic halo were seen in the other patient. On color Doppler study, the thyroid parenchyma was slightly hypervascular to markedly hypervascular. The findings in our study were consistent with those of Anderson et al 2010 [30] and Langer et al 2001 [29].

Thyroid neoplasm

A total of 13 patients comprised of this subgroup. Benign lesion adenoma was noted in 6 patients while 7 patients had malignant thyroid neoplasm.

Papillary carcinoma

Papillary carcinoma was the commonest primary thyroid malignancy encountered in this study comprising of 57.1% cases. The majority of the lesions had cystic consistency; various authors have documented the manifestations of papillary carcinoma in the form predominantly cystic lesion. First such case was reported by Allen et al in 1997. The other authors reporting such an appearance include Simeone et al 1982[22,23], Hatabu et al 1991[11,15], Barki 1992, Lu C 1994. Heteroechogenicity was noted in most lesions with predominant hypoechoeic echopattern. Hyperechoeic echopattern which has been documented in literature by Solbiati et al 1985[16] and Lu C et al 1994, was not observed in my study group. Thick, irregular or incomplete halo was noted in 3 cases. Coarse and rim calcification was not noted in any patient but microcalcification less than 1 mm was observed in 3 cases. In 3 cases margins of the lesions were irregular or ill-defined. Colour flow imaging showed predominantly intralesional flow in 3 cases. There was one case in which thin and complete halo was noted with no calcification. The lesion showed well defined margins and on colour Doppler flow imaging showed intralesional and peripheral flow. Sonographically it was diagnosed as benign lesion, but on pathological examination it was proved to be papillary carcinoma.

Extrathyroid involvement was noted in the form of lymphadenopathy in all cases while muscle infiltration, tracheal extension and retrosternal extension were not noted in any case.

Follicular carcinoma:

There were two cases of follicular carcinoma, all lesions were of solid consistency and hypoechoeic echotexture and had a thick incomplete halo with ill defined margins radiologically. No calcification was observed in any case. The mass in both cases had clustered intranodular flow on colour Doppler study which was not seen in any benign lesion and hence this appearance is considered to be an important sonographic feature in diagnosing thyroid malignancy.

Extra thyroid involvement in the form of lymphadenopathy was noticed in both the cases.

Follicular adenoma:

Follicular adenoma was noted as well defined solid lesions with variable parenchymal echotexture in 83.3% cases and thin, complete halo surrounding the lesion in 66.6% cases. Most of the lesions were hyperechoic. No calcification was seen in 4 cases (66.6%). Mixed consistency with solid and cystic areas was noticed in one case. On colour Doppler examination showed perilesional vascularity in all cases.

There were two cases which were seen with hetroechoic echopattern and showed irregular, incomplete halo with microcalcifications and illdefined margins and on colour Doppler flow imaging study showed intranodular and perilesional flow. Sonographically these were diagnosed as malignant lesions but on pathological examination these were found to be benign follicular adenoma.

Anaplastic Carcinoma:

One case of anaplastic carcinoma was included in the study. Patient was of elderly age. There was diffuse involvement of the thyroid by a solid, hypoechoic lesion with illdefined margins and microcalcification. Extra thyroid involvement in the form of cervical lymphadenopathy, carotid and internal jugular vein engulfment was noted. Solbiati et al in 1985 described the common presentation of anaplastic carcinoma in ederly as solid hypoechoeic mass. Hatabu et al in 1991[11,15] described the sonographic findings in four cases of anaplastic carcinoma which included a poorly marginated hypoechoeic mass or masses associated with calcification and invasion of surrounding structures.

Sonographic distinction between malignant and benign lesions:

The majority of malignant thyroid lesions were found to be solid in consistency.

Higher percentage of solid component in malignant lesions has been reported in many studies Solbiati et al 1985[16], Simeone et al 1982 [22,23], Allen et al 1979[13] , Mehta et al 1994.

Predominant echopattern observed in malignant lesions was hypoechoeic. Similar observations have been documented by various authors Solbiati et al 1985[16], Simeone et al 1982[22,23], Mehta et al 1994.

Microcalcification was observed in 4 (57.1%) cases of thyroid malignancy which was not observed in any other thyroid pathologies. A high specificity of microcalcification for malignancy has documented by various authors Gorman et al 1987 Solbiati et al 1991[16], Takashima et al 1995[14], Jain et al 1997.

The non specificity of perinodular halo in distinguishing benign and malignant lesions has been documented by various authors Proper et al 1980, Hiyashi et al 1980[24], Solbiati et al 1985[16], Simeone et al 1982[22,23]. However the presence of halo has been observed more often in benign lesions by Hiyashi et al 1980[24], Solbiati et al 1985[16], Simeone et al 1982[22,23], jain et al 1997 in their study group. Similar observation was made in the present study which revealed halo in 66.6% of benign lesions while 14.2% of malignant nodules also demonstrated a halo.

As many as 85.7% malignant nodules showed illdefined margins while 66.6% benign lesions had well defined margins. Higher incidency of illdefined, irregular margins in malignant lesions has been reported by various authors Hiyashi et al 1980[24], Austin et al 1982[27], Beygket et al 1983, Solbiati et al 1985[16], Barki et al 1992, Jain et al 1997.

Invasion of anatomic structures around the thyroid was observed in 14.2% cases in the form of vessels infiltration. Local invasion was found to be highly specific for thyroid malignancies in their study group by Solbiati et al 1992[16], Hiyashi et al 1986[24]. Cervical adenopathy was seen in 100% cases of malignancy and 33.3% cases of follicular adenoma Solbiati et al 1992[16] described cystic degeneration as pathognomic for metastatic nodes from

malignant carcinoma which was seen in 2 cases of papillary carcinoma in my study group.

SUMMARY AND CONCLUSION

The following conclusions were drawn from the present study:

- High resolution sonography is a useful modality for evaluation of thyroid diseases.
- It is reliable in distinguishing normal from abnormal thyroid.
- Thyroid sonography is useful in defining whether the patient has a diffuse abnormality, a multinodular pathology or a solitary nodule.
- It is an excellent modality for morphological characterization of thyroid lesions.
- High resolution sonography can differentiate benign from malignant thyroid nodules and masses in majority of cases.
- Sonography is very sensitive in detecting local invasion by thyroid malignancies. However, the substernal and retrosternal components of thyroid masses cannot be adequately imaged due to technical constraints.
- It is useful in diagnosis and follow up of diffuse thyroid diseases i.e. thyroiditis.
- It is a useful imaging modality in evaluation of thyroid in children and pregnant women.
- Sonography can be used precisely to guide FNAC from impalpable thyroid lesions.
- Color flow imaging gives useful information about the vascular status of the lesions in thyroid and helps in characterizing indeterminate lesions in some cases.

High resolution sonography is recommended as the primary imaging modality in evaluation of thyroid diseases. It has a high sensitivity and specificity in the diagnosis of thyroid diseases.

BIBLIOGRAPHY

1. Chaudhary V, Bano S. Imaging of the thyroid: Recent advances. Indian J Endocr Metab 2012; 16: 371-6
2. Mazzaferri E. Management of a solitary thyroid nodule. N Engl J Med 1993; 328:553–559.
3. Carroll B. Asymptomatic thyroid nodules: incidental sonographic detection. AJR Am J Roentgenol 1982; 138:499–501.
4. Woestyn J, Afschrift M, Schelstraete K, Vermeulen A. Demonstration of nodules in the normal thyroid by echography. Br J Radiol 1985; 58:1179–1182.
5. Brander A, Viikinkoski V, Nickels J, Kivisaari L. Importance of thyroid abnormalities detected at US screening: a 5-year follow-up. Radiology 2000; 215: 801–806.
6. Mortenson J, Woolner L, Bennett W. Gross and microscopic findings in clinically normal thyroid glands. J ClinEndocrinol Metab 1955; 15:1270–1280.
7. Papini E, Guglielmi R, Bianchini A, et al. Risk of malignancy in non-palpable thyroid nodules: predictive value of ultrasound and color Doppler features. J ClinEndocrinol Metab, May 2002, 87(5):1941–1946
8. Chammas MC, Gerhard R, Oliviera IRSD, et al Thyroid nodules: evaluation with power Doppler and duplex Doppler Ultrasound. Otolaryngology, head and neck surgery 2005; 132:874-882
9. Bartolotta TV, Midiri M, Quaia E, Bertolotto M, Galia M, Cademartiri F, et al. Benign focal liver lesions: Spectrum of findings on SonoVue enhanced pulse-inversion ultrasonography. EurRadiol. 2005;15:1643–9.
10. Frates MC, Benson CB, Charboneau JW, Cibas ES, Clark OH, Coleman BG, et al. Management of thyroid nodules detected at US: Society of Radiologists in Ultrasound consensus conference statement. Radiology. 2005;237:794–800
11. Hatabu H, Kasagi K, Yamamoto K et al. Undifferentiated carcinoma of the thyroid gland: Sonographic findings. Clin Radiology 1992; 45: 307-310.
12. Ishigaki S, Shimamoto K, Satake H, et al. Multislice CT of thyroid nodules: comparison with ultrasonography. Radiat Med 2004; 22:346-353
13. Leopold GR : Thyroid cancer, Med Clinics North America Am 1991, 75;211.

14. Takashima S, Morimoto S, Ikezob J et al. Primary thyroid lymphoma: Comparison of CT and US assessment. Radiology 1989; 171: 439-443.
15. Kasagi K, Hatabu H, Tokuda Y et al. Lymphoproliferative disorder of the thyroid gland: Radiological appearances BJR 1991 July; 64: 569-575.
16. Solbiati L, Cioffi V, Ballarati E. Ultrasonography of neck. RCNA 1992 Sept; 30(5): 941-54.
17. Scheible W, Leopold GR, Woo VL et al. High resolution real time ultrasonography of thyroid nodules. Radiology 1979 Nov; 133 : 413-417
18. Blum M, Weiss B, Herberg J. Evaluation of thyroid nodules by A-mode echography. Radiology 1971 Dec; 101:651-656.
19. Blum M. Enhanced clinical diagnosis of thyroid disease using echography. The American Journal of Medicine 1975 Sept; 59(3) : 301-307.
20. Blum M, Passalaqua AM, Sackler JP et al. Thyroid echography of subacute thyroiditis. Radiology 1977 Dec; 125: 795-798.
21. Sackler JP, Passalaqua AM, Blum M et al. a spectrum of diseases of the thyroid as imaged by gray scale water bath sonography. Radiology 1977 Nov; 125: 467-472.
22. Simeone JF, Daniels GH, Mueller PR et al. High resolution real time sonography of the thyroid. Radiology 1982 Nov; 145: 431-435
23. Simeone JF, Daniels GH, Hall DA et al. Sonography in the follow up of 100 patients with thyroid carcinoma. AJR 1987 Jan; 148: 45-49.
24. Hayashi N, Tamaki N, Yamamoto K et al. Real time ultrasonography of thyroid nodules. ActaRadiologica Diagnosis 1986; 27:404-408.
25. Nam-Goong IS , Kim HY , Gong G , et al. Ultrasonography-guided fine-needle aspiration of thyroid incidentaloma: correlation with pathological findings . ClinEndocrinol (Oxf) 2004 ; 60 (1): 21 – 28 .
26. Katz JF, Kane RA, Reyes J, Clarke MP, Hill TC. Thyroid nodules sonographic-pathological correlation. Radiology 1984; 151: 741-745.
27. Austin CW. Ultrasound evaluation of thyroid and parathyroid disease. Seminars in ultrasound 1982; Dec; 3(4): 250-62.ko
28. Ralls PW, Mayekawa DS, Lee KP et al. Colour flow Doppler sonography in Graves disease: "Thyroid inferno". AJR 1988; 150: 781-784.
29. Langer JE, Khan A, Nisenbaum HL, et al. Sonographic appearance of focal thyroiditis. AJR 2001; 176:751–754.
30. Anderson L, Middleton WD, Teefey SA, Reading CC et al. Hashimoto Thyroiditis: Part 1, Sonographic Analysis of the Nodular Form of Hashimoto Thyroiditis. American Journal of Roentgenology. 2010;195: 208-215.

How to cite this article: Jain N, Brahmbhatt P, Chaudhuri CR et.al. Ultrasonography of thyroid lesions with clinicopathological correlation. International Journal of Research and Review. 2020; 7(1): 142-158.

******