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Morphological Evaluation of Thyroid Lesions using High Resolution Ultrasonography and Cross Sectional Imaging in a Tertiary Care Center

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Abstract: ***Background: Thyroid diseases are second most common type of endocrine disorders. Timely and correct diagnosis helps in effective management of thyroid diseases. For diagnosis of thyroid diseases priority is always given to the clinical and imaging methods. Ultrasound examination is commonest examination after physical examination. It is easily available, non-invasive and highly informative. Sonography can be easily applied as a screening method to detect the people with an increased risk of thyroid pathology. Objectives: To evaluate the role of various radiological imaging modalities in thyroid gland lesions for pre-operative preparation. To evaluate ultrasonographical features of different thyroid lesions. Materials and Methodology: A prospective observational study carried out over a period of one and half year. A detailed clinical history was taken from enrolled patients and thorough local examination was carried out. Relevant laboratory investigations, Thyroid function Tests, were done as per the requirement. Radiological evaluation was done with X-ray soft tissue neck, high resolution gray scale color Doppler ultrasonography, and whenever required CT scan and MRI were done. The collected data were analysis using Microsoft Excel. Observations: During study period total numbers of 70 patients with thyroid lesions were included in the study. Nearly 60% of cases were from 31-50 years of age with male to female ratio was 1:4.4. Among all the cases commonest thyroid lesions was goiter (65.7%) followed by thyroid neoplasm (15.7%), Hashimoto thyroiditis (10%), and Graves diseases (4.3%). Conclusion: High resolution ultrasonography is an excellent modality for distinguishing normal from abnormal thyroid lesions and for morphological characterization of thyroid lesions. CT scan plays an important role in evaluating thyroid masses with sub-sternal or retro tracheal extension. CT scan is superior to sonography in staging of thyroid malignancies.***

Keywords: Ultrasonography finding, thyroid lesions, abnormal morphology

1. Introduction

Thyroid diseases are second most common type of endocrine disorders after Diabetes Mellitus. It is registered in 8-20 % of adult population which increases up to 50% in some endemic regions. [1,2] Timely and correct diagnosis helps in effective management and also reduces cost of therapy. Some of the common methods utilized for differential diagnosis of thyroid lesions are clinical examination like palpation of thyroid gland and lymph nodes, evaluation of thyroid hormone and TSH in blood, FNAC and histo-pathological examination of thyroid tissue, and also radiological evaluation by high definition ultrasonography, CT scan and MRI.

For diagnosis of thyroid diseases priority is always given to the method of visualization like ultrasound examination, computed tomography, MRI and radionuclide scan. [3] One should use different methods in optimal combination and sequence to reveal functional and structural changes.

Ultrasound examination is commonest examination after physical examination. Ultrasound is easily available, non-invasive and highly informative. Also there is no proven adverse effect of medical diagnostic ultrasound exceed the risk and unwanted effects. Ultrasound can be used intra-operatively and can detect 25% more thyroid lesions as compared to preoperative ultrasound. [4] If cost effectiveness and diagnostic value considered, Ultrasound is over as compared to other newer radiological examinations like CT scan, MRI Scan.

As the location of thyroid gland is superficial, high resolution ultrasound and color Doppler gives very clear picture of normal thyroid and also easily differentiate various pathological lesions of thyroid gland. [5] The Ultrasound examination of the thyroid provides precise information on thyroid volume and structure and now is considered as one of the most reliable method of determining thyroid volume [6]. Sonography can be easily applied as a screening method to detect the people with an increased risk of thyroid pathology.

The aim of the study was to evaluate the role of various radiological imaging modalities in thyroid gland lesions for pre-operative preparation. To evaluate ultrasonographical features of different thyroid lesions.

2. Methodology

It was prospective observational study conducted by department of Radio-diagnosis of a tertiary care Hospital in south Gujarat area. Study was conducted over a period of 18 months which include data collection, data analysis from July 2015 to December 2016. Human Research Ethics Committee permission was taken before starting the study.

The patients matching the inclusion criteria were included, and those falling within the exclusion criteria and not affirming to the consent or procedural guidelines were eliminated out of the study.

Inclusion Criteria

- Patients who have presented with a clinically palpable neck mass and/or abnormal thyroid function test.
- Only those patients who were willing to participate were included.
- Patient referred to radiology department for USG and/or CT scan investigation and found to have lesion were included in this study.

Exclusion Criteria

- Post-operative patients.
- Patients with contraindications to intravenous administration to contrast medium.
- Pregnant females.
- Neck mass other than thyroid origin

All the patients referred from the Out Patient Department and indoor of department of Surgery, ENT, Medicine and Pediatrics were explained about the study and written informed consents were taken from each of them prior to the study. The participants were allowed to withdraw from the study whenever they wished.

A detailed clinical history was taken from patient and thorough local examination was carried out which includes Chief Complaints like lump in the neck, fever, local pain and tenderness, symptoms of thyrotoxicosis or hypothyroidism. Relevant laboratory investigations, Thyroid function Tests, were done as per the requirement.

3. Radiological Evaluation of Patient

- X-RAY SOFT TISSUE NECK: Polydoros 800 mAs X-ray machine (Siemens) and mars 50-500 mAs x-ray machine (allengers) were used for the x-ray of the neck. Both projections antero-posterior and lateral view were taken .Antero-posterior(AP) view: Patient position: place the patient in upright, seated or standing position whenever possible. Position of part: Center the mid saggital plane of body to the midline. Ask the patient to sit or stand straight. Adjust the patient shoulder to lie in same horizontal plane to prevent rotation of head and neck. Extend the patient head enough to prevent shadow of mandible in the film. Centre of IR: At the level or just below laryngeal prominence. Image receptor(IR): 8 X10 inch or 10 X 12 inch Source to image distance- 40 inch (100 cm), X-ray exposure: KVp- 75-85, mAs- 8-10 Lateral view: Patient position: ask the patient to stand or sit upright in lateral position before the vertical grid device. Position of part: ask the patient to sit or stand straight with the adjacent shoulder resting firmly against the stand for support. Adjust the body that mid-sagittal plane is parallel with the plane of IR. Depress the shoulder as much as possible and adjust them to lie in same transverse plane. Extend patient head slightly. Immobilize the head by the patient look at an object in line with the visual axis. Centre of IR: 1. 1 inch below external acoustic meatus (EAM) for nasopharynx. 2. At the level of mandibular angles to show oro-pharynx. 3.At the level of laryngeal prominence to show larynx, laryngeal pharynx and upper end of esophagus. Image receptor(IR): 8 X10 inch . Source to image distance- 72inch (180 cm) , X-ray exposure: KVp- 65-70 for upper part of traches and area of larynx and 80-85 for lower portion of trachea , mAs- 8-10
- ULTRASONOGRAPHY: High-resolution real time ultrasonography of the neck was done in all patients with 12L-RS (5-13 MHz) linear probe and 4C-RS convex probe (2-5.5 MHz) (when required) on GE Voluson S8 or linear array (3.5-12 MHz) and curved array (2-5 MHz) (when required) on Phillips envisor Diagnostic ultrasound system installed in Department of Radio-diagnosis. After informed consent the sonographic examination of the neck was performed in supine position, with the neck hyper extended and a pillow place under the shoulders for optimal exposure of the neck. Examination was done in both longitudinal and transverse planes to evaluate the mass for its size, shape, consistency (solid/cystic) echogenicity, Internal architecture, presence of septa, calcifications necrosis, margins were also made note of. In all cases, it was tried to find out the site of origin, the extent of the lesion and its relation to surrounding structures.
- COMPUTED TOMOGRAPHY: A plain as well as contrast enhanced CT scan of neck was carried out in the patients when its required, Phillips MX- 16 slice CT scan machine. Serial axial sections were taken from the base of the skull to the arch of aorta in craniocaudal orientation with 5 mm collimation at the interval of 3 mm and reformatted to coronal and sagittal sections. Thin collimation (3 mm) and 3 mm interval was used in areas where high spatial resolution was required. Omnipaque (iohexol) non-ionic contrast was used in quantities varying with the body weight (usually between 80 – 100 ml at the rate of 2-3 ml/second) and the lesions were assessed in various stages. The site, size and extent of the lesion were evaluated. The margins, relation to adjacent structures and the tissue attenuation values were also made note of Intra-cranial and intra-thoracic extension of lesion was carefully looked for. Observed the patient after the completion of examination for any adverse contrast media reaction.
- MRI SOFT TISSUE NECK: MRI were done in the patients whenever required. Patients were asked to remove all metallic objects like coin, keys, wallet, magnetic strips, hair pin etc. Contrast injection risk and benefits were explained to patient before the scan. Explained procedure to patient and instructed to keep still during procedure. Patient given position in supine with head first and arms besides the trunk. Head and neck coil was used. Scout image is sagittal T1 and scan range is in axial plane from thoracic inlet to base of the skull by using 3-5 mm slice thickness and slice interval of 0-1 mm. Intravenous contrast injection was optional in cases where it can add diagnostic information, dose of contrast (omniscan) was 0.2 ml / kg and scan delay of 180-300 second. Pulse sequences to be taken were T1 spine echo in the axial and sagittal plane.T1W with fat supression, T2 fast spin echo with and without fat saturation in axial plane, GRE axial images and post contrast T1 spin echo with fat saturation in axial and coronal plane.

Statistical methods: All collected data from the patients included within the present study were analysis using

Microsoft Excel. Data analysis was done by appropriate statistical tests (descriptive analysis- rate, ratio, proportion). Various validity indicators of the test (such as sensitivity, specificity, positive predictive value, negative predictive value) were calculated wherever applicable. The data classified accordingly and frequencies described in number and their respective percentage. As there was no comparison group in this study, statistical method for level of significance is not included.

Strict confidentiality of their personal details and information related to the study will be maintained at all level.

4. Results

During the study period of one and half year a total numbers of 106 patients evaluated for neck masses. Among them pathologies involving the thyroid diseases were 70 in numbers.

Table 1: Age distribution of all patients with thyroid lesions

Age group (in years)	Thyroid	Percentage (%)
0-10	2	2.86
11-20	5	7.14
21-30	11	15.71
31-40	22	31.43
41-50	19	27.14
51-60	5	7.14
61-70	4	5.71
More than 71 years	2	2.86
Total	70	100

Table 1 shows the age wise distribution of patients with highest numbers of patients were in 31 – 40 years of age (31.43%) followed by 41 – 50 years (27.14%) and 21 – 30 years (15.71%). The gender wise distribution shows thyroid lesions are more than four times in female than the male with male to female ratio was 1:4.4. (Figure 1).

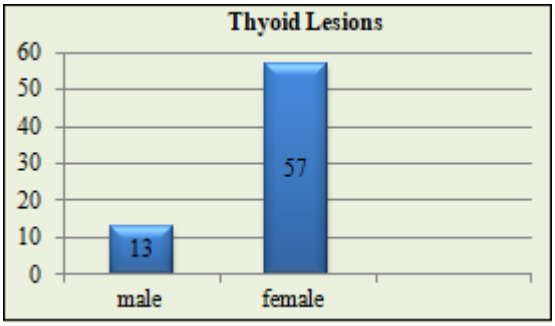


Figure 1: Gender wise distribution of all patients with thyroid lesions

Table 2: Incidence of various thyroid diseases by pathologic examination (n = 70)

Thyroid Lesions	Male	Female	Total
Non-toxic goiter	6	25	31 (44.3%)
Toxic nodular goiter	2	13	15 (21.4%)
Graves disease	1	2	3 (4.3%)
Hashimoto thyroiditis	1	6	7 (10.0%)
Thyroid adenoma	1	3	4 (5.7%)
Ectopic thyroid	0	1	1 (1.4%)
Thyroid neoplasm	2	5	7 (10.0%)
Thyroglossal cyst	0	2	2 (2.9%)
Total	**13**	**57**	**70 (100%)**

Final diagnosis of all patients was done by histo-pathological examination. Table 2 shows Incidence of various thyroid diseases by histo-pathological examination in both male and female. Non toxic goiter (44.3%) was the highest among the all thyroid lesions and also female had highest incidence of non-toxic goiter cases that is 25 cases. Other thyroid lesions like toxic nodular goiter, Hashimoto Thyroiditis, Benign and Malignant thyroid lesions were also common among female patients.

Clinically 38 patients found to have solitary thyroid nodule. However Ultrasonography shows out of those 38 participants, 16 had Multinodular goiter. (Table 3)

Table 3: Clinical versus Ultrasonography in detection of thyroid nodularity in all thyroid lesions.

Nodularity		Noof cases
Clinical findings	Solitary Thyroid Nodule	38 (100%)
Ultrasonography findings	Solitary Thyroid Nodule	22 (57.9%)
	Multi Nodular Goiter	16 (42.1%)

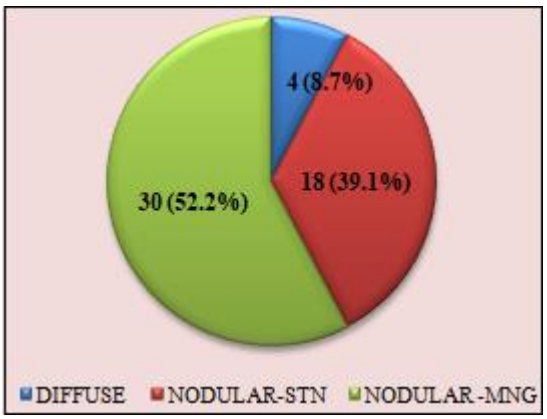
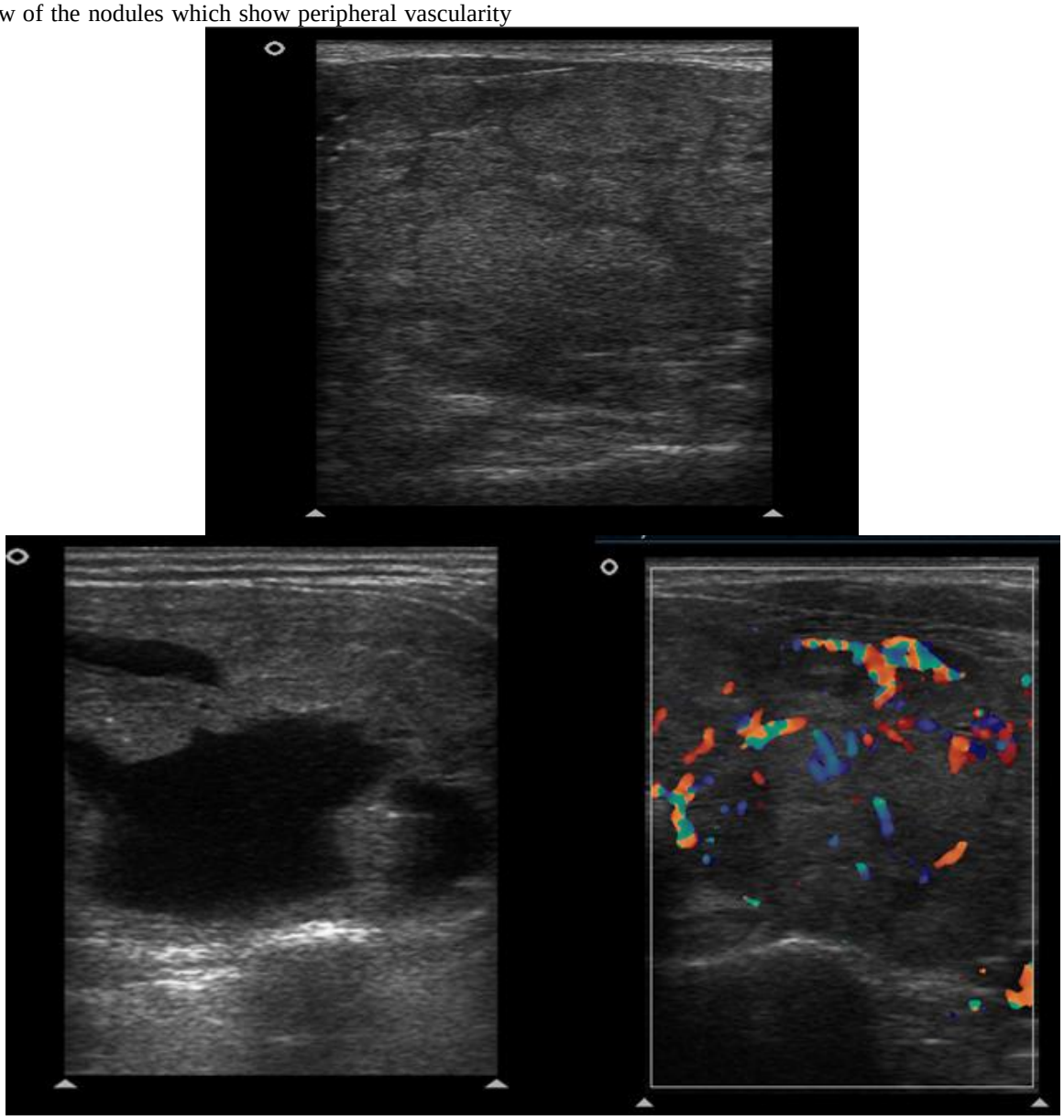


Figure 2: Type of involvement of thyroid parenchyma in toxic and non toxic goiter (n =46)

Total cases of goiter were 46. Among them Simple Diffuse Goiter was seen in only 8.7%. While Multinodular goiter was in 52.2% and solitary nodular goiter was 39.1%. (Figure 2) The distribution of all thyroid patients according to consistency shows that 32.6% had solid, 8.7% had entirely cystic, and 13.1% had predominantly cystic consistency. While, majority of patients with nodular goiter had mixed consistency (45.6%). Among the STN, majority nodules of colloid goiters were isochoeic (66.8%) with cystic degeneration being present in 55.6% cases. In MNG most of the nodules of colloid goiter were isoechoeic with cystic degeneration being present in 62.4% of cases. (Picture 1) Calcification is present in 33.3% of cases of MNG with 25% have coarse calcification and 8.3% have microcalcifation. (Table 4) Two patients with STN had intra-nodular flow pattern on colour Doppler study, however 72.2% of patient with STN shows peripheral vascularity. Most of the patients with multinodular goiter show inter-nodular vascularity (75%). (Table 5)

Picture 1: Multinodular goiter:
Transverse images of the both lobe of the thyroid gland shows the increases in the size of the thyroid gland multiple

well defined , hyperechoeic and internal cystic areas noted in the few of the nodules which show peripheral vascularity of colour Doppler examination



Transverse images of the both lobe of the thyroid gland shows the increases in the size of the thyroid gland multiple well defined, hyperechoeic and internal cystic areas noted in the few of the nodules which show peripheral vascularity of colour Doppler examination.

Table 4: USG features of goiter presenting as Solitary Thyroid Nodule (n = 18) and Multi Nodular Goiter (n = 24)

Ultrasound features	Solitary Thyroid Nodule (n= 18)	Multi Nodular Goiter (n = 24)
Echo pattern		
Anechoeic	02 (11.1%)	03 (12.5%)
Hypoechoeic	02 (11.1%)	02 (8.3%)
Isoechoeic	12 (66.8%)	14 (58.3%)
Hyperechoeic	01 (5.5%)	01 (4.2%)
Heteroechoeic	01 (5.5%)	04 (16.7%)
Total	18 (100%)	24 (100%)
Consistency		
Predominantly cystic	07 (38.9%)	02 (8.3%)
Enrtirely cystic	03 (16.7%)	02 (8.3%)
Solid	05 (27.8%)	09 (37.6%)
Mixed	03 (16.7%)	11 (45.8%)
Total	18 (100%)	24 (100%)
Margins		
Well-defined	18 (100%)	24 (100%)
Ill defined	0 (0.0%)	0 (0.0%)
Calcifications		
Coarse calcification	4 (22.2%)	6 (25.0%)
Rim calcification	0	0 (0.0%)
Micro-calcification	0	2 (8.3%)

Table 5: ColourDoppler changes solitary thyroid nodule (n = 18) and Multi Nodular Goiter (n = 24)

Colour Doppler findings	solitary thyroid nodule (n = 18)	Multi Nodular Goiter (n = 24)
Avascular	03 (16.7%)	00 (0.0%)
Intra-nodular flow	02 (11.1%)	06 (25.0%)
Inter-nodular flow	13 (72.2%)	18 (75.0%)

Total 7 cases were diagnosed as Hashimoto's thyroiditis. In findings of ultrasonographic examination all were predominantly hypoechoeic pattern and increased in the gland sized. Nodularity was seen in the 4 number (57.1%) of cases. Nearly half of the patients (57.1%) had normal

vascularity, while 28.1% patients had increased vascularity observed among all cases of Hashimoto's thyroiditis. Cervical lymphadenopathy was seen in the 42.9% of patients. (Table 6)

All the 3 cases, which diagnosed as Graves' disease, were found to have predominantly hypoechoeic pattern and increased in the gland sized in ultrasonographic examination. Also increased vascularity is observed in all the three cases of Graves' disease. (Table 6)

Table 6: Ultrasonographic appearance of thyroid in patients of hashimoto's thyroiditis(n = 07) and Graves disease (n = 03)

USG features	Hashimoto's thyroiditis(n = 7)	Graves disease (n = 03)
Gland size		
Increased	7 (100.0%)	3(100.0%)
Normal	0 (0.0%)	0 (0.0%)
Reduced	0 (0.0%)	0 (0.0%)
Echo-pattern		
Hypoechoeic	7 (100.0%)	3(100.0%)
Hyperechoeic	0 (0.0%)	0 (0.0%)
Isoechoeic	0 (0.0%)	0 (0.0%)
Cystic degeneration		
Cystic degeneration	00 (0.0%)	00 (0.0%)
Nodularity		
Nodularity	04 (57.1%)	00 (0.0%)
Vascularity		
Increased	02 (28.6%)	3(100.0%)
Normal	04 (57.1%)	0 (0.0%)
Reduced	01 (14.3%)	0 (0.0%)
Lymphadenopathy		
Cervical lymphadenopathy	03 (42.9%)	00 (0.0%)

Pathological examination showed that, out of 11 cases with thyroid neoplastic lesions, 4 cases were follicular adenoma and 7 cases were the malignant thyroid lesions. Among malignant lesions, 3 (42.8%) cases were diagnosed as papillary carcinoma, 2 (28.6%) cases were follicular and 2 (28.6%) cases were anaplastic carcinoma. (Table 7) Ultrasonographically follicular adenoma of thyroid gland was well-defined, solid lesions with variable parenchymal echotexture in 04 cases. Coarse calcification was noted in 25% case while rim calcification in 25% case of benign follicular adenoma. Also, perilesional vascularity was seen in 75% cases followed by intralesional vascularity in follicular adenoma cases. Ultrasonography of malignant thyroid lesions show heterogenous echo pattern in all 3 papillary carcinoma, while hypoechoeic pattern in follicular and anaplastic carcinoma. Micro calcifications was seen in the 42.8% of the cases of malignant thyroid neoplasm however it was absent in benign neoplasm.

Table 7: Distribution of thyroid neoplasm as found at pathologic examination (n = 11)

Pathology	No. of cases		
	M	F	Total
Benign Thyroid Lesions			
Thyroid Adenoma	1	3	4 (100%)
Malignant Thyroid Lesions			
Papillary	1	2	3 (42.8%)
Follicular	1	1	2 (28.6%)
Anaplastic	1	1	2 (28.6%)

5. Discussion

Ultrasound has been used to distinguish normal from abnormal thyroid and to classify the abnormalities as focal or diffuse. Sonography has also been used to characterize the morphology of the lesion and suggest a pathologic diagnosis. The role of high resolution sonography has expanded to assess the local extent of the lesions and guide FNAC wherever indicated.

In present study age range of the patients in the study was 8 to 82 years. The female preponderance was noted in patients and the overall sex ratio was M: F- 1:4.4. A similar female preponderance in thyroid diseases was noted by Solbiati et al in 1985 and Brander et al in 1991 in their respective study groups. [7, 8] In present study there was higher incidence of all thyroid diseases in females. Solbiati et al in 1985 had also observed similar female preponderance in both benign and malignant thyroid nodular lesions. [7]

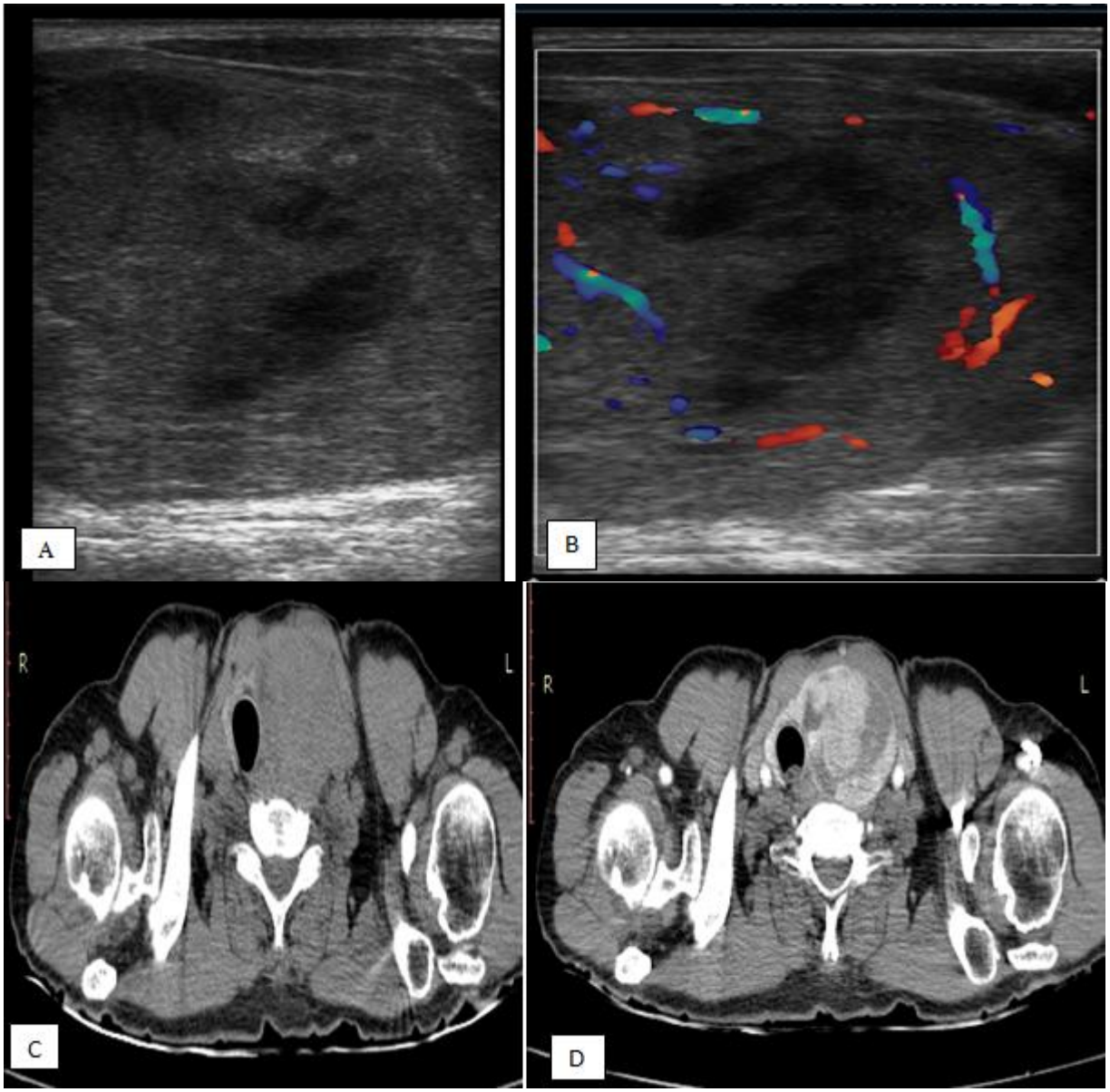
Hyperplastic goiter was found to be as commonest pathology in the present study. A variable incidence has been reported in various literatures. All four patients with diffuse thyroid involvement showed heteroechoeic echo-texture of thyroid. Similar type of consistency and echotexture were observed by Blum et al 1977, Scheible et al 1978. Solbiati et al 1985 in their respective study groups. [7, 9, 10] Lymphadenopathy and local invasion were not noted in any patient with hyperplastic goiter. Similarly gray scale findings have been reported by various i.e., Simeone et al 1982, Solbiati et al 1985 and Gooding 1993 et. al. [7, 11, 12] CT scan was done in cases which showed retro-sternal extension of the thyroid mass with well-defined and clear planes around it. It had inhomogeneous low density in Non-Contrast CT while marked inhomogeneous enhancement was noted in post contrast study. However, CT scan plays an essential role for evaluation of larger goiter which could not be evaluated completely on USG either because of its size or for is retro-sternal extension. Similar role of CT scanning was documented in previous studies.

Among the Grave's disease patients thyroid was bulky in 1 out of 3 cases with prominent thyroid septae and capsule, one patient had no parenchymal changes with no prominence of septae or capsule which is concurrent with Solbiati et al 1985. [7] These findings were also consistent with other similar studies like Goodings et al 1993, Hopkins et al 1995. [12, 13] Colour Doppler revealed increase vascularity in all cases, which is referred to as thyroid inferno pattern, Such appearance was not seen in any other thyroid diseases findings are concurrent with those of Ralls et al 1988.

All Hashimotos' cases had solid hypoechoeic parenchymal echopattern. There was evidence of nodularity in three patients and it was not possible to distinguish them sonographically from multi nodular colloid goiter (MNG). Three patients had neck lymphadenopathy. Patients had typical diffusely heterogeneous echotexture with multiple small hypoechoeic areas interspersed throughout the thyroid parenchyma. Calcification was not seen in any of the cases. Similar USG findings have been reported by various authors, Nordmeyer et al 1990, Hopkins ct al 1995, Blum et

al 1977. [13, 14, 15] Colour Doppler showed diffuse parenchymal flow of low to medium velocity in all the patients. Similar colour Doppler findings have been observed in various other studies.

Follicular adenoma on ultrasonography was noted as well-defined lesions with variable parenchymal echotexture in 04 cases. CT scan imaging of adenoma was that of a well-defined hypodense nodule on Non-Contrast CT which showed uniform intense enhancement on post contrast studies. Follicular carcinoma lesions of thyroid were of solid consistency and hypoechoeic. The mass in two cases had clustered intranodular flow on colour Doppler study which was not seen inany benign lesion and hence this appearance is considered to be an important sonographic feature in diagnosing thyroid malignancy. Papillary carcinoma was the commonest primary thyroid maligancy encountered in this study comprising of 42.8 % cases. Heteroechogenecity was noted in most lesions with predominant hypoechoeicechopattern. (Picture 2)



Picture 2: Papillary carcinoma of Thyroid

Carcinoma of thyroid :(fig A, B) large well defined heterogenous lesion is seen involving the left lobe and ishmus of thyroid gland with internal cystic areas and vascularity, (fig. C, D) on CECT neck axial images shows large well defined heterogeously enhancing lesion involving left lobe and ishmus of thyroid gland with lateral displacement of the trachea on right side and left carotid artery laterally with restrosternal extension.

Hyperechoeicechopattern which has been documented in literature by Solbiati et al 1985, was not observed in present study group. [7] CT scan was able to delineate the exact extent of these locally invasive and huge tumors which emphasizes the limitation on high resolution Sonography inevaluating large tumours and signifies the role of CT scanning in evaluating large thyroid masses along with staging of thyroid malignancies. On ultrasonography, anaplastic carcinoma cases showed extra-thyroid involvement in the form of cervical lymphadenopathy, muscle infiltration and carotid engulfment was noted. Solbiati et.al in 1985 described the common presentation of

anaplastic carcinoma in elderly as solid mass. Hatabu et.al in 1991 described the sonographic findings in four cases of anaplastic carcinoma which included a poorly marginated, irregular, hypoechoeic mass or masses associated with calcification and invasion of surrounding structures. [16] Microcalcification was observed in one case of thyroid malignancy, which was notobserved in any other thyroid pathologies. Ring or egg shell calcification has been documented by various authors to be reliable indicator of benign nature of lesion [Solbiati et al 1985]. As many as 71.4% malignant modules showed ill-defined margins while all benign lesions had well defined margins. Higher incidence of ill defined, irregular margins in malignant lesions had been reported by various authors like Hatabu et al 1991. [16]

Two cases of Thyroglossal cyst with hypo to anchoeic lesion in the midline of the neck above thyroid cartilage was found. On MRI on T1W images appears hypointense and appears hyperintense on T2W and STIR images with internal nodular enhancement on post contrast study, which on histopathology it turn out to be squamous cell carcinoma. In present study one case with ectopic thyroid with sublingual location which have well defined margin and isocheoeicecho pattern, was found on ultrasonography.

High resolution ultrasonography is an excellent modality for distinguishing normal from abnormal thyroid lesions and for morphological characterization of thyroid lesions. Ultrasonography is sensitive in detecting local invasion by thyroid malignancies. CT scan plays an important role in evaluating thyroid masses with sub-sternal or retro tracheal extension which can't be adequately imaged by high resolution USG and detection of calcifications. CT scan is superior to sonography in staging of thyroid malignancies.

References

[1] Ross DS1Evaluation of the thyroid nodule.JNucl Med. 1991 Nov;32(11):2181-92.
[2] Kalinin AP, Pavlov AV, Alexandrov YK, Kotova IV, Patrunov YN, Pamputis SN. The parathyroid glands: imaging and surgery. Springer Science & Business Media; 2012 Sep 24.
[3] Kotlyarov PM, Vinikovetskaya AV, Gvarishvili MA, Shaduri EV, Egorova EV. Radiation diagnostics of mesenchymal non-organ tumors of the retroperitoneal space.Medical imaging. 2009 (2): 52-8.
[4] Vetshev PS, Kuznetsov NS, Bel'tsevich DG, Ozerov SK. Potentialities of ultrasound examination in differential diagnosis of benign nodules and breast cancer. Khirurgiia. 1997 Jan 1(6):15-20.
[5] Rumack CM, Wilson SR, et al: Diagnostic ultrasound. Third edition 2005; Vol.1, page 735-767.
[6] S. Peterson, A. Sanga, H. Ekl¨of et al., "Classification of thyroid size by palpation and ultrasonography in field surveys," Lancet, vol. 355, no. 9198, pp. 106–110, 2000
[7] Solbiati L, Volterrani L, Rizzatto G, Bazzocchi M, Busilacci P, Candiani F, Ferrari F, Giuseppetti G, Maresca G, Mirk P, et al. The thyroid gland with low uptake lesions: evaluation by ultrasound. . Radiology. 1985 Apr;155(1):187-91.
[8] Brander A, Viikinkoski P, Nickels J, Kivisaari L. Thyroid gland: US screening in a random adult population. Radiology. 1991 Dec;181(3):683-7.
[9] Blum M, Passalaqua AM, Sackler JP, Pudlowskl R. Thyroid echography of subacute thyroiditis. Radiology. 1977 Dec;125(3):795-8.
[10] Scheible W, Leopold GR, Woo VL, GosinkBB.Radiology. High-resolution real-time ultrasonography of thyroid nodules.1979 Nov;133(2):413-7.
[11] Simeone JF, Daniels GH, Mueller PR, Maloof Fet. alHigh-resolution real-time sonography of the thyroid..Radiology. 1982 Nov;145(2):431-5. PubMed PMID: 7134448…./////
[12] Gooding GA1.Sonography of the thyroid and parathyroid.RadiolClin North Am. 1993 Sep;31(5):967-89.
[13] 13. Richard Hopkins Carl C Reading Rumack Diagnostic Ultrasound Volume 1 edition 2 731-741.
[14] Nordmeyer JP, Shafeh TA, HeckmannC.Thyroid sonography in autoimmune thyroiditis. A prospective study on 123 patients. 122.
[15] Blum M, Passalaqua AM, Sackler JP, PudlowskiR,Thyroid echography of subacute thyroiditis. 6. Radiology. 1977 Dec; 125 (3): 795-8.
[16] Hatabu H, Kasagi K, Yamamoto K, Kubo S, Higuchi K, Hidaka A, Misaki T, Iida Y, Sakahara H, Yamabe H, et al.Undifferentiated carcinoma of the thyroid gland: sonographic findings.ClinRadiol. 1992 May;45(5):307-10.

Tables and Figures:

Table 8: USG features of Benign Thyroid Adenoma (n = 04) and Malignant thyroid lesions (n = 07)

USG features	Benign Thyroid Adenoma (n=04)	Malignant Thyroid Lesions		
		Papillary carcinoma (n=3)	Follicular carcinoma (n=2)	Anaplastic carcinoma (n=2)
Echopattern				
Hypoechoeic	04 (100.0%)	00 (0.0%)	02 (100.0%)	02 (100.0%)
Hyperechoeic	00 (0.0%)	00 (0.0%)	00 (0.0%)	00 (0.0%)
Isoechoeic	00 (0.0%)	00 (0.0%)	00 (0.0%)	00 (0.0%)
Haterogeneous	00 (0.0%)	03 (100.0%)	00 (0.0%)	00 (0.0%)
Calcification				
Coarse	01 (25.0%)	00 (0.0%)	01 (50.0%)	00 (0.0%)
Rim	01 (25.0%)	01 (33.3%)	00 (0.0%)	00 (0.0%)
Microcalcifications	00 (0.0%)	01 (33.3%)	00 (0.0%)	01 (50.0%)
Nodularity				
Solitary nodule	00 (0.0%)	02 (66.7%)	02 (100.0%)	00 (0.0%)
Multinodularity	00 (0.0%)	01 (33.3%)	00 (0.0%)	00 (0.0%)

Vascularity of lesion				
Internal	02 (25.0%)	03 (100.0%)	02 (100.0%)	02 (100.0%)
Peripheral	03 (75.0%)	00 (0.0%)	00 (0.0%)	00 (0.0%)
Avascular	00 (0.0%)	00 (0.0%)	00 (0.0%)	00 (0.0%)
Margins				
Well define	04 (100.0%)	01 (33.3%)	01 (50.0%)	00 (0.0%)
Ill define	00 (0.0%)	02 (66.7%)	01 (50.0%)	02 (100.0%)
Cystic degeneration				
Cystic degeneration	00 (0.0%)	01 (33.3%)	00 (0.0%)	00 (0.0%)

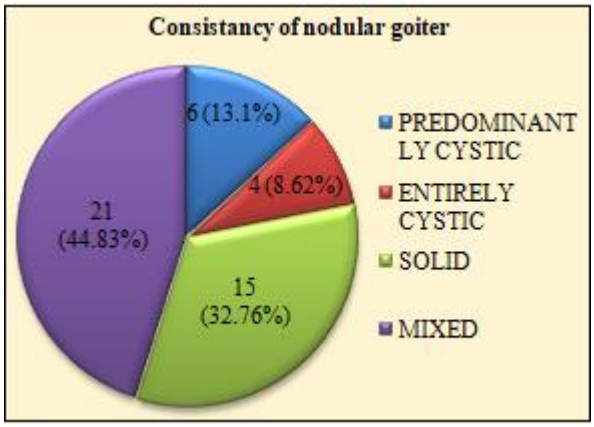


Figure 3: Consistency of nodular goiter lesions as seen Ultrasonographically.(n =46)