STUDY TOPIC- ROLE OF USG AND CT IN IMAGING OF THYROID LESIONS

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ABSTRACT

BACKGROUND

Thyroid lesions are the most common abnormality in the endocrine system. The importance of imaging is that cancers of the thyroid must be differentiated from the much more frequent benign adenomas and multinodular goiters.

METHODS

Study of 97 patients was carried out. All patients diagnosed and suspicious of thyroid lesions were included in my study. Patients referred to the radiology department for USG and/or CT scan thorax investigations, and found to have thyroid lesion, were included in this study.

RESULTS

In our study, there was a higher incidence of all thyroid diseases in females. The overall sex ratio was M:F = 1:4.7. Most of the patients were in the 31-40 yrs. age group. The largest group was comprised of non-toxic goitre followed by thyroid neoplasms. Most of the patients had multinodular type of goiter followed by solitary nodular goiter. Simple diffuse goiter was seen only in 10.5% cases. Majority of the patients showed mixed consistency, followed closely by solid consistency. Majority of the malignant lesions was papillary type of carcinoma (46%) followed by follicular carcinoma (20%) and metastasis (13.3%).

CONCLUSIONS

USG had high sensitivity of 86.6% and specificity of 96.5% in differentiating benign from malignant thyroid lesions which was better than that of CT scan which had a sensitivity of 66.6% and specificity of 80%. CT scan was found to be useful in staging of thyroid malignancies.

KEYWORDS

Thyroid Nodule, Benign, Malignant, USG, CT Scan.

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BACKGROUND

Any thyroid swelling is an ominous sign and warrants evaluation as thyroid cancer.

There are various modalities which can be used for the characterisation of thyroid lesions, which include USG (high-end) and CT scan (for staging of the neoplasm).

As per statistics, 4% of the population is afflicted by this disease, however thyroid nodules may be present in 20% or more of adults subjected to routine thyroid echography.

By far the most sensitive imaging test available for thyroid gland examination is high end USG. Its role has been enumerated as follows.

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- To differentiate between possible benign and probably malignant masses, based on their sonographic appearance.
- To detect thyroid and cervical masses, including relapse in the thyroid bed and cervical adenopathy after thyroidectomy.
- To guide the performance of FNA biopsy and percutaneous treatment.

CT plays minimal role in the diagnosis but is a game changer in terms of further management of the patient, as it is imperative for staging of the neoplasm.

Scintigraphy is not used routinely to assess thyroid nodules. It allows assessment of the functional activity of a thyroid nodule and of the whole gland. A functioning, or "hot," thyroid nodule is rarely malignant, with only a few reported cases of such malignancy.[1-8] Although a non-functioning, or "cold," nodule at scintigraphy is commonly thought to indicate an increased risk of thyroid malignancy, as many as 77% of cold thyroid nodules may be benign.[2] Thyroid scintigraphy therefore is unhelpful for differentiating a benign nodule from a malignant one, and its utility for the routine evaluation of thyroid nodules is limited.

Aims and Objectives

1. To study role of USG and CT scan in diagnosis of thyroid lesions.
2. To know merits and demerits of different modalities over one another.
3. To know the sensitivity and specificity of USG and CT scan in evaluation of thyroid lesion with final pathological diagnosis.
4. To evaluate the occurrence of thyroid pathologies according of age, sex and etiological factors.

METHODS

A prospective study of 97 patients was carried out. The cases were recruited from the teaching hospitals attached to GCRI, Ahmedabad. From January 2018 to January 2019.

Inclusion Criteria

- All patient diagnosed and suspicious of thyroid lesions were included in our study.
- Patients referred to the radiology department for USG and/or CT scan thorax investigations, and found to have thyroid lesion, were included in this study.
- Already diagnosed cases of such thyroid disease which need follow up radiological investigations and are referred to our radiology department were included in study.

Exclusion Criteria

- All patients with contrast allergy and contraindications to CT scan procedure, were excluded from my study.
- Patients presenting to radiology department having thyroid lesion in past and are cured completely were excluded from the study.

RESULTS

The present study was a prospective type of study. A total of 97 patients evaluated for thyroid diseases,

The overall sex ratio was M:F = 1:4.7.

Female preponderance was noted in all age group except in 61-70 yrs. age group where there was equal number of male and female patients. The age range of the patients in the study was 8 yrs to 78 yrs.

Largest numbers of patients were in the 31-40 yrs. age group.

The female preponderance was noted in patients and the overall sex ratio was M:F = 1:4.7. In my study there was higher incidence of all thyroid diseases in females.

As mentioned above most of the nodules of colloid goiter were isoechoic with cystic degeneration being present in 70% cases. A thin well defined complete halo was seen in 69.5% cases. Calcification is present in only 21% cases.[9]

Extra thyroid involvement was noted in 14 patients and lymph nodes were the most common site of extra thyroid extension.

Out of 10 pts of benign thyroid lesion CT scan showed retro sternal extension of the thyroid mass in 4 cases (40%) with well-defined and clear planes around it. Degenerative changes were noted in 40 cases of thyroid lesions.

Sr. No.		USG Features	Adenoma n= 8	%	p Ca n=7	F ca n=3	M ca n= 1	A ca n=1	Mets n=2	ymphoma n= 1	%
1	Consistency	solid	6	75	5	3	1	1	1	1	80
		mixed	2	25	1	0	0	0	1	0	13.4
		predominantly cystic	0	0	1	0	0	0	0	0	6.6
2	Echo pattern	hypoechoic	1	12.5	3	2	1	1	1	1	60
		isoechoic	2	25	0	1	0	0	0	0	6.6
		hyperechoic	3	37.5	0	0	0	0	0	0	0
		Hetero-echoic	2	25	4	0	0	0	1	0	33.4
3	Halo	thin, complete, well-defined	7	87.5	1	1	0	0	0	1	20
		irregular/incomplete/thick/absent	1	12.5	6	2	1	1	2	0	80
4	Calcification	coarse	2	25	0	1	1	0	0	0	13.3
		microcalcification	0	0	2	0	0	0	0	0	13.3
		rim calcification	1	12.5	1	0	0	0	0	0	6.6
		no calcification	5	62.5	4	2	0	1	2	1	66.7
5	Margins	well-defined	8	100	2	1	0	0	1	1	33.3
		ill-defined/irregular	0	0	5	2	1	1	1	0	66.7
6	Extra thyroid involvement	nodes	0	0	7	0	1	1	2	1	80
		muscle invasion	0	0	1	0	0	1	0	0	13.3
		tracheal infiltration	0	0	0	0	0	0	0	0	0
		vessel infiltration	0	0	1	0	0	1	1	0	2
7	Multi focal		0	0	2	0	0	1	1	1	33.3

Table 1. Sonographic Features of Thyroid Neoplasms

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

Sr. No	CT Diagnosis	CT Findings								USG Diag.	Pathological Diagnosis
		Involvement	Location	Margins	Degeneration		Contrast enhancement	Extension	lymph nodes	Distant Mets	
1	Colloid goitre	Solitary focal	one lobe	well defined	cystic	-	In homogeneous		+	-	Solitary goitre	Papillary CA
2	Benign lesion	solitary focal	one lobe	well defined	-	-	minimal	-	+	-	Metastasis	Metastasis
3	Secondary lymphoma	multifocal	both lobes	well defined	-	-	minimal	-	+	-	Lymphoma	Lymphoma
4	Colloid goitre	solitary focal	one lobe	well defined	cystic	-	In homogeneous		+	-	Colloid goiter	Papillary CA
5	Metastasis from oesophagus	multifocal	both lobes	irregular	-	-	inhomogeneous	vessel involvement	+	-	Metastasis	Metastasis
6	Malignant lesion	multifocal	both lobes	Ill-defined	necrosis	Rim and punctate calcification	inhomogeneous	retrosternal, muscle infiltration	+	-	Papillary ca	Papillary CA
7	Malignant lesion	solitary focal	Crossing isthmus	Ill-defined	-	Micro-calcification	inhomogeneous	-	+	-	Medullary ca	Medullary CA
8	Malignant lesion	multifocal	one lobe	Ill-defined	-	Micro-calcification	inhomogeneous		+	-	Papillary ca	Papillary CA
9	Malignant lesion	Multi focal	Crossing isthmus	Ill-defined	necrosis	-	inhomogeneous	muscle involvement, vessel encasement	+	+	Malignant lesion	Anaplastic Ca.
10	Malignant lesion	solitary focal	right lobe	Ill-defined	necrosis	-	inhomogeneous	tracheal involvement	+	-	Papillary ca	Papillary CA
11	Benign adenoma	solitary focal	right lobe	well defined	-	Coarse calcification	inhomogeneous	-	-	-	Suspicious nodule	Follicular CA
12	Malignant lesion	solitary focal	left lobe	Ill-defined	-	-	inhomogeneous	-	-	+	Malign ant nodule	Follicular Ca.

Table 2. CT Findings in Case of Malignant Thyroid Lesions

Sr. No.	Staging[10]		Diagnosis		Additional Benefit of CT Scanning	Pathological Diagnosis
	USG	CT	USG	CT		
1	-	-	Colloid goiter	Colloid goiter	NIL	Papillary CA
2	-	-	Malignant Nodule	Benign lesion	NIL	Metastasis
3	-	-	Lymphoma	Secondary lymphoma	Complete analysis of all LNs	Lymphoma
4	T1N1	-	Malignant Nodule	Colloid goitre	NIL	Papillary CA
5	-	-	Metastasis	Metastasis from oesophagus	Retrosternal portion evaluated	Metastasis
6	T4N1	T4N1	Papillary	Malignant lesion	Retrosternal portion evaluated	Papillary CA
7	T3N1	T3N1	Medullary CA	Malignant lesion	NIL	Medullary ca
8	T2N2	T2N2	Papillary CA	Malignant lesion	NIL	Papillary CA
9	T4N2	T4N2	Malignant Mass	Malignant lesion	Retrosternal portion evaluated	Anaplastic CA
10	T2N1	T4N1	Papillary CA	Malignant lesion	Tracheal infiltration detected	Papillary CA
11	-	-	Benign adenoma	Benign adenoma	NIL	Follicular CA
12	T1N1	T1N1	Malignant Nodule	Malignant lesion	Distant metastasis detected	Follicular CA
13	NA	NA	MNG	Large mass probably malignant	Retrosternal portion evaluated	Goitre
14	NA	NA	MNG	Multi nodular goitre	NIL	Colloid goiter
15	NA	NA	MNG	Multinodular goitre	Retrosternal portion evaluated	Goitre
16	NA	NA	? Malignant Nodule	Follicular adenoma	NIL	Benign Follicular aetiology
17	NA	NA	Solitary nodular goitre	Benign solitary Nodule	NIL	Colloid goiter

18	NA	NA	MNG	Large mass probably malignant	Retrosternal portion evaluated	Colloid goiter
19	NA	NA	MNG	Benign solitary mass	NIL	Goitre
20	NA	NA	benign adenoma	Follicular adenoma	NIL	Benign Follicular aetiology
21	NA	NA	Solitary nodular goitre	Benign solitary nodule	NIL	Hyperplastic goitre
22	NA	NA	Colloid goitre	Colloid goitre	NIL	Colloid goiter

Table 3. Comparison of CT Findings With USG and Pathological Diagnosis

On CT examination of malignant thyroid lesions, 60% lesions show ill define margin, 80% lesion shows inhomogeneous enhancement and 33% lesions shows calcification. In study of 734 patients Yoon at al. found that signs of malignancy on CT could include nodular or rim calcifications (46.7% malignant versus 13.3% benign), an anteroposterior-transverse diameter ratio greater than 1 (33.3% versus 9.5%), and mean contrast-enhanced attenuation higher than 130 HU (86.7% versus 49.5%). The overall malignancy rate was 9.4%.

In 72% cases finding of two modalities were comparable. Retrosternal extension and staging was better done with CT in 9 case out of 22 cases (40%). however Sonography found better for prediction of malignancy, local invasion.

Sonography was found better for evaluation of goiter, for local invasion and nodal metastasis.

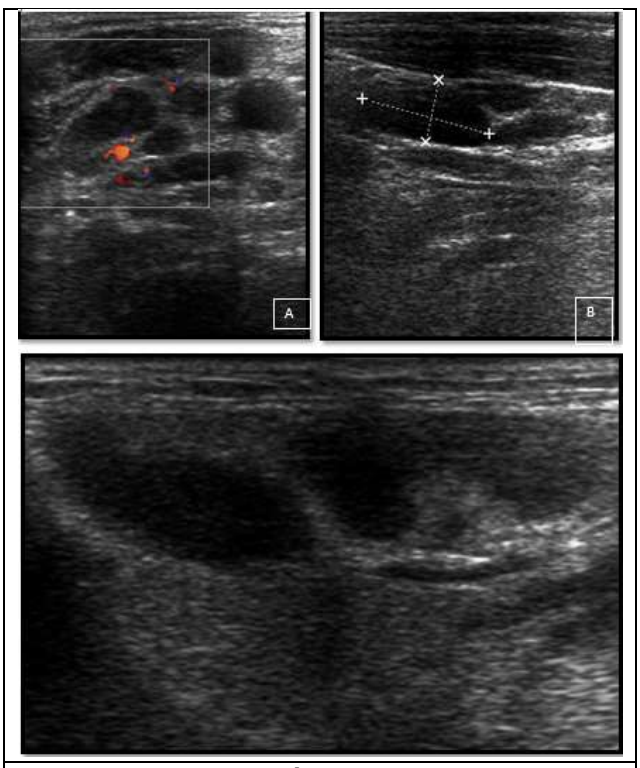

Figure 1

Metastasis involving cervical lymph nodes (case no. 3): Spectrum of appearances, A. Multiple small round to oval hypoechoic lymph nodes, despite their small size the round shape and hypoechoic patterns are highly indicative of metastasis; B. Showing a lymph node with cystic change. Cystic change in cervical lymph nodes is almost always caused by metastatic papillary carcinoma; C. an enlarged reactive lymph node with intact hilum as insignificant finding.

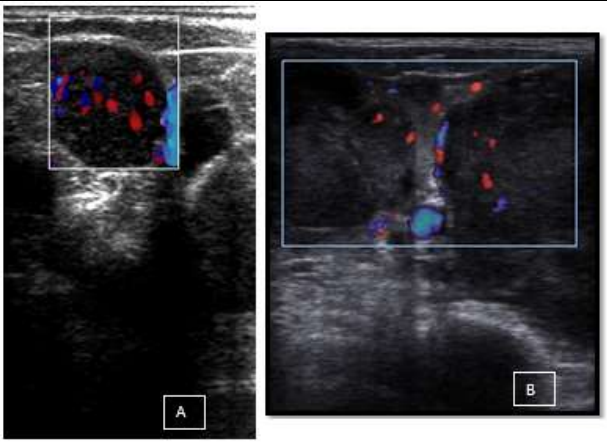

Figure 2

Thyroid Metastasis (case no. 21): A. transverse scan images showed a solid homogeneously hypoechoeic mass that is showing intra-nodular vascularity this was a metastatic lesion from Bronchogenic adenocarcinoma; B. An ill-defined diffusely infiltrating hypoechoic mass lesion which was a metastatic lesion from carcinoma oesophagus.

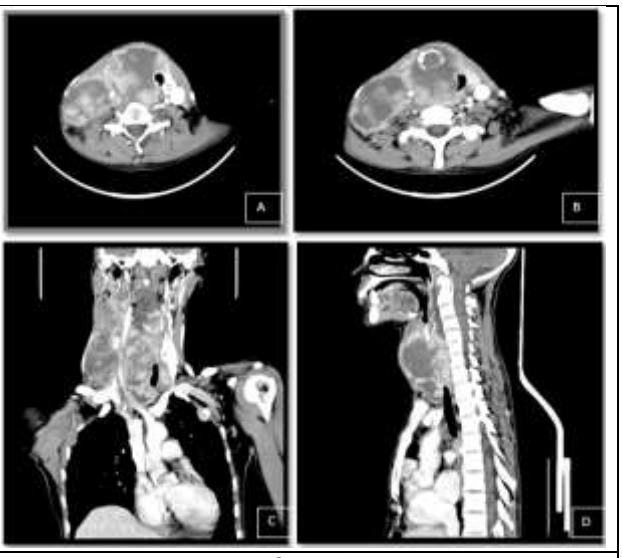

Figure 3

Papillary Carcinoma (case no. 3), Typical appearance: CECT shows A. heterogeneously enhancing mass in the right lobe and the isthmus of thyroid causing contralateral displacement of trachea and ipsilateral displacement of carotid sheath vessels; B. Curvilinear rim type calcification is seen in the mass; C and D. There are multiple well

circumscribed enlarged necrotic cervical lymph nodes seen along the right internal jugular vein.

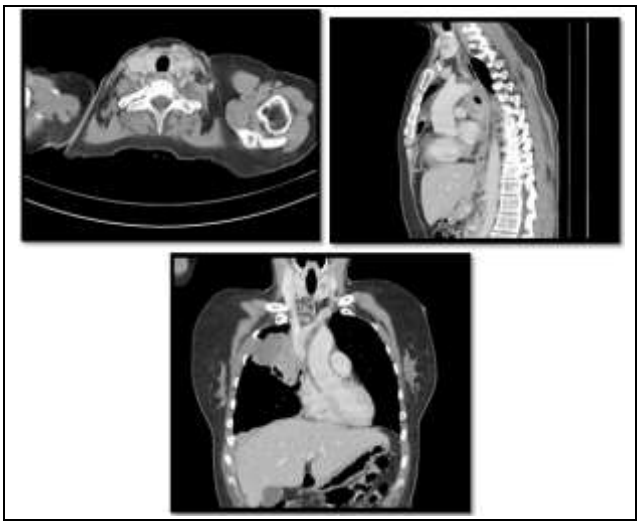

Figure 4

Metastatic Adenocarcinoma (Case no. 21): CECT scan in a known case of Bronchogenic carcinoma showing a(images A and B)hypodense nodule in the left lobe of thyroid and coronal image (C), shows primary mass in the lung. FNAB suggest metastatic carcinoma from primary carcinoma of lung.

Diagnostic Accuracy of CT Scan in Thyroid Diseases

- CT scan could correctly distinguish between normal and abnormal thyroid in all cases
- Accuracy of high-resolution CT scanning in distinguishing malignant from benign thyroid lesion was calculated as follows: -
  i. **True Positive (TP):** Malignancy diagnosed by CT and at pathologic examination[8] True Negative (TN): Malignancy excluded by CT and at pathologic examination.[8]
  ii. **False Positive (FP):** Malignancy diagnosed by CT and not found on pathologic examination.[2]
  iii. **False Negative (FN)**: Malignancy excluded by CT and pathology revealing malignancy.[4]

$$\textbf{Sensitivity:} \quad \frac{TP}{TP+FN}\times 100 = 66.6\%$$

$$\textbf{Specificity:} \quad \frac{TN}{TN+FP}\times 100 = 80.0\%$$

$$\textbf{Positive Predictive Value:} \quad \frac{TP}{TP+FP}\times 100 = 80.0\%$$

$$\textbf{Negative Predictive Value:} \quad \frac{TN}{TN+FN}\times 100 = 66.6\%$$

DISCUSSION

ACR Thyroid Imaging Reporting and Data System (ACR TI-RADS) is a reporting system for thyroid nodules on ultrasound proposed by the American College of Radiology (ACR).

This uses a standardised scoring system for reports providing users with recommendations for when to use fine needle aspiration (FNA) or ultrasound follow-up of suspicious nodules, and when to safely leave alone nodules that are benign/not suspicious.

Ultrasound Features

Scoring is determined from five categories of ultrasound findings (Figure 2). The higher the cumulative score, the higher the TR level and likelihood of malignancy.

One score is assigned from each of the following categories:

Composition: (choose 1)

i. Cystic or completely cystic: 0 points
ii. Spongiform: 0 points
iii. Mixed cystic and solid: 1 point
iv. Solid or almost completely solid: 2 points

Echogenicity: (choose 1)

i. Anechoic: 0 points
ii. Hyper- or isoechoic: 1 point
iii. Hypoechoic: 2 points
iv. Very hypoechoic: 3 points

Shape: (choose 1) (assessed on the transverse plane)

i. Wider than tall: 0 points
ii. Taller than wide: 3 points

Margin: (choose 1)

i. Smooth: 0 points
ii. Ill-defined: 0 points
iii. Lobulated/irregular: 2 points
iv. Extra-thyroidal extension: 3 points
v. Any and all findings in the final category are also added to the other four scores.

Echogenic foci: (choose 1 or more)

i. None: 0 points
ii. Large comet tail artefact: 0 points
iii. Macrocalcifications: 1 point
iv. Peripheral/rim calcifications: 2 points
v. Punctate echogenic foci: 3 points

The findings in each category were detailed in the ACR committee's 2015 publication on a reporting lexicon 2. If multiple nodules are present only the four highest scoring nodules (not necessarily the largest) should be scored, reported, and followed up.

Scoring and Classification

TR1: 0 points
Benign

TR2: 2 points
Not suspicious

TR3: 3 points
Mildly suspicious

TR4: 4-6 points
Moderately suspicious
TR5: ≥7 points
Highly suspicious

Recommendations
TR1: no FNA required
TR2: no FNA required
TR3: ≥1.5 cm follow up, ≥2.5 cm FNA
Follow up: 1, 3 and 5 years
TR4: ≥1.0 cm follow up, ≥1.5 cm FNA
Follow up: 1, 2, 3 and 5 years
TR5: ≥0.5 cm follow up, ≥1.0 cm FNA
Annual follow up for up to 5 years

Thyroid lesions were noted in both males and females with a female preponderance with the overall sex ratio was M:F = 1:4.[5]

Thus USG is better in differentiate between possible benign and probably malignant masses, based on their sonographic appearance. Also it is helpful to detect thyroid and cervical masses, including relapse in the thyroid bed and cervical adenopathy after thyroidectomy. My observations have been enumerated as follows,

- The largest group comprised of nontoxic goitre followed by thyroid neoplasms.
- Most of the nodules of colloid goiter were isoechoic
- Most of the patients with thyroid neoplasms had solid lesions (80%). Predominant echo pattern was that of hypo echogenicity (60%) Multi nodularity in thyroid was seen in 33% cases on USG. Absent halo noted in 80% cases. Micro calcification was seen in 3(20%) cases which were diagnosed on histopathology as papillary carcinoma. Coarse calcification was noted in 2 patients one was medullary carcinoma and in one with follicular carcinoma. Rim calcification was noted in one case of papillary carcinoma. 42% cases of papillary carcinoma shows calcification.
- Predominant vascularity pattern in benign thyroid neoplasm was perilesional blood flow.

Summary
The present study was a prospective type of study. Total 97 number of patients from were recruited. All Patients that came to the radiology department with clinical suspicion of thyroid diseases at Gujarat cancer and research institute, consisted the study material.

Out of the 97 cases studied 17 (17.5%) were men and 80 (82.5%) were women. This clearly shows predilection of thyroid diseases in females. Maximum number (28/97, 29%) of patients were within age group 31-40 years. The most common complain noted in (57 patients; 55%) was 'lump in the neck'.

The distribution of thyroid diseases as found in my study were:

1. Non-toxic goitre: 47 cases (49%)
2. Malignant thyroid neoplasm: 15 cases (16%)
3. Toxic nodular goitre: 10 cases (10%)
4. Hashimoto's thyroiditis: 10 cases (10%)
5. Thyroid adenoma: 8 cases (8%)
6. Grave's disease: 5 cases (5%)
7. Thyroglossal cyst: 1 case (1%)
8. Ectopic thyroid: 1 case (1%)

Benign vs. Malignant lesions: The sonographic features favouring malignancy were-

- Predominantly solid lesions.
- Hypoechoic echo pattern in a solid lesion.
- Thick, irregular and incomplete halo
- Ill-defined margins.
- Microcalcifications.
- Local invasion.
- Significant cervical lymphadenopathy.
- Intralesional vascularity on colour Doppler.

1. High end USG is a useful modality for distinguishing thyroidal from extrathyroidal neck masses.
2. It is dependable in differentiation normal from abnormal thyroid.
3. Thyroid USG is useful in specifically defining whether the patient has a diffuse abnormality, a multinodular pathology or a solitary nodule.
4. High resolution sonography can differentiate benign from malignant thyroid nodules in maximum of the cases.
5. High end USG is better than CT scan in differentiating benign from malignant thyroid nodules and masses.
6. USG is very sensitive in detecting local invasion by thyroid malignancies. Tracheal and strap muscles infiltration and carotid sheath entrapment can be accurately diagnosed.

Thus, high end USG is recommended as the primary imaging modality in the evaluation of thyroid diseases. It has a high sensitivity and specificity in the diagnosis of thyroid diseases.[5]

CONCLUSIONS
USG has a high sensitivity of 86.6% and specificity of 96.5% in differentiating benign from malignant thyroid lesion and also classifies the abnormalities as focal and diffuse which was better than that of CT scan which had sensitivity of 66.6% and specificity of 80%. USG also helps in guiding FNAC wherever indicated. CT scan was found useful in only staging of the thyroid malignancies.

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