

Original Research Article

Role of Ultrasound in Thyroid Pathologies

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Abstract

Disorders of thyroid gland may result from developmental failures, abnormalities of hormone production and structural changes which may or may not be accompanied by changes in function. The normal thyroid gland consists of two lobes and a bridging isthmus. Thyroid size, shape and volume vary with age and sex. Ultrasound is the initial and the commonest modality to study the thyroid gland. The thyroid gland is slightly more echo-dense than the adjacent structures because of its high iodine content. It has a homogenous ground glass appearance that makes detection of focal cystic or hypoechoic thyroid lesions relatively easy. The aim of the present study was to assess the nature of pathologies of thyroid gland, differentiate between focal and diffuse pathology and perform a Sonographic interpretation with subsequent confirmation by FNAC. The present prospective observational study was carried out in the Department of Radio-Diagnosis, Government Medical College and Associated Hospitals Srinagar. A convenience sampling of all patients referred to the Department of Radio-Diagnosis from OPD, in-patient wards or Emergency wing for thyroid ultrasound scan were included in study. Detailed history was elicited; Study was done on Logic S8 Ultrasound using 12 MHz linear array transducer. Before the ultrasound guided FNAC, the neck was hyperextended and skin was cleaned with povidine – iodine (Betadine) solution. The male: female ratio was 1:2.3. Maximum number of patients, 42(84%) came with clinically thyroid enlargement followed by pain in 7 cases (14%), 6(12%) cases presented with pressure effects like dysphagia, dyspnoea and hoarseness of voice. 3(6%) cases presented with signs of hyperthyroidism like tremors, sweating and loss of weight. Lesser involvement was seen in Left Lobe (8%). Total number of cases with swellings (84%) was more than cases (16%) with no swellings. In the study, majority of lesions had hypoechoic echotexture (34%) followed by isoechoic (28%) and heterogenous (24%). In this study among malignant cases papillary carcinoma was most common lesion in 83.34% of cases followed by anaplastic carcinoma in 1(16.66%) case.

Key words

Thyroid, USG, FNAC, Papillary carcinoma, Hashimoto's thyroiditis.

Introduction

Thyroid gland consists of two symmetrical lobes united in front of the second, third and fourth tracheal rings by an isthmus of gland tissue. Apart from its own thin capsule an envelope of pretracheal fascia encloses it. Each lateral lobe is pear shaped with a narrow upper pole and broader lower pole and appears approximately triangular in cross section with lateral, medial and posterior surfaces [1].

Disorders of thyroid gland may result from developmental failures, abnormalities of hormone production and structural changes which may or may not be accompanied by changes in function. The normal thyroid gland consists of two lobes and a bridging isthmus. Thyroid size, shape and volume vary with age and sex. Normal thyroid lobe dimensions are: 18-20 mm longitudinal and 8-9 mm antero-posterior (AP) diameter in newborn; 25 mm longitudinal and 12-15 mm AP diameter at one year age; and 40-60 mm longitudinal and 13-18 mm AP diameter in adult population. The limits of normal thyroid volume (excluding isthmus, unless its thickness is >3 mm) are 10-15 ml for females and 12-18 ml for males [2].

The incidence of all thyroid diseases is higher in females than in males. Nodular thyroid disease is the most common cause of thyroid enlargement. Broadly thyroid diseases are classified into 3 categories: (1) Benign thyroid masses (2) Malignant tumours of thyroid gland, and (3) Diffuse thyroid enlargement [3].

Nodularity within thyroid is the norm. The incidence and development of nodules correlate directly with age of the patient and is regarded as a part of normal maturation process of the thyroid gland. The incidence of thyroid nodules is very high on USG, ranging from 50% to 70% [4]. Structural and local functional changes

within gland may be identified using a variety of imaging techniques [5].

Ultrasound is the initial and the commonest modality to study the thyroid gland. The thyroid gland is slightly more echo-dense than the adjacent structures because of its high iodine content. It has a homogenous ground glass appearance that makes detection of focal cystic or hypoechoic thyroid lesions relatively easy. Before the advent of high resolution ultrasound radionuclide scintigraphy was the chief means to evaluate the thyroid gland both functionally and morphologically. On radionuclide imaging, 4% of hot nodules are shown to contain tumor, compared with 16% of cold nodules. Thus, radionuclide imaging is unreliable in excluding or confirming the presence of cancer [6].

Computed tomography (CT) and magnetic resonance imaging (MRI) have a limited role in the initial investigation of a patient presenting with a thyroid nodule. The newly developed high resolution ultrasonography with color Doppler flow mapping can reveal fine details of the thyroid gland and the hemodynamic features of thyroid neoplasms. Thus, the combination of conventional sonography and color flow doppler provides benefits in increasing the screening, sensitivity and accuracy in distinguishing malignant thyroid nodules [7].

USG features predictive of malignant nodules include presence of microcalcifications (<2 mm), local invasion, lymph node metastases, marked hypoechogenicity, irregular margins, solid composition, absence of a hypoechoic halo around the nodule, size >1 cm, taller-than-wide-shape, and an intra-nodular vascularity [8]. Thyroid US is useful for the initial diagnosis and follow-up of patients with subacute granulomatous thyroiditis. The characteristic US findings for this disease are an ill-defined hypoechoic area, without round or

ovoid mass formation on the multiple planes of US, and no vascular flow on color Doppler US [9]. The aim of the present study was to assess the nature of pathologies of thyroid gland, differentiate between focal and diffuse pathology and perform a Sonographic interpretation with subsequent confirmation by FNAC.

Materials and methods

The present prospective observational study was carried out in the Department of Radio-Diagnosis, Government Medical College and Associated Hospitals Srinagar from August 2016 to February 2018. A convenience sampling of all patients referred to the Department of Radio-Diagnosis from OPD, in-patient wards or Emergency wing for thyroid ultrasound scan were included in study. After setting the primary inclusion criteria as, clinically palpable swelling in the thyroid region, clinical suspicion of thyroid dysfunction, Pain in thyroid region, congenital abnormalities of thyroid gland patient selection was done. All those patients not willing to undergo ultrasonography and fine needle aspiration cytology were excluded.

Detailed history was elicited, followed by a focused clinical examination and relevant laboratory investigations of every patient prior to Ultrasonography of thyroid as per the annexed proforma. A brief account of the procedure was explained to the patients with emphasis on reassuring them prior to the procedure. Informed and written consent was taken from the patients / attendants. Study was done on LOGIC S8 Ultrasound using 12 MHz linear array transducer. Patients were examined in the supine position with an extended neck. A pillow was placed under the shoulders to provide better exposure of the neck. Thyroid being a superficial organ, a linear 7.5 to 10 MHz linear array transducer was used. Entire gland was scanned in longitudinal and transverse planes. The gland was evaluated using the well-established criteria of solid, mixed and cystic pattern. Solid nodules were divided into homogeneous and heterogenous pattern, homogeneous pattern of

lesion were further subdivided into hyperechoic, isoechoic and hypoechoic echotexture.

Before the ultrasound guided FNAC, the neck was hyperextended and skin was cleaned with povidine – iodine (Betadine) solution. The needle used for thyroid FNAC was standard 1^{1/2}” 25 gauge, non-cutting beveled edge needle. The needle was attached to 10ml syringe. After introducing the needle, the needle was moved gently but rapidly through the nodule centre under USG guidance. Two drops of the aspirate/fluid in the syringe were ejected over a clean slide and with the help of the other blank slide with 60 angle, the aspirate on the first slide was spread on it to form a film of coating on it. Two slides in alcohol along with container were sent to Pathology Department for cytopathological study.

Results

The present study was undertaken in the Department of Radiodiagnosis and Imaging, Government Medical College Srinagar and Associated Hospitals on 50 patients referred from OPD, IPD and Emergency wing of various Postgraduate Departments with symptoms of thyroid disease.

In this study youngest patient was 12 years of age and oldest was 70 years of age. Maximum number of cases were in age group of 31 -40 years (42%) followed by 41-50 years (**Table - 1**). It was also seen that in this study out of 50 patients 35 (70%) patients were females and only 15(30%) were males. The male: female ratio was 1:2.3.

Table - 2 presents the distribution of the subjects according to their gender. In this study out of 50 patients 35 (70%) patients were females and only 15(30%) were males.

In this study, maximum number of patients, 42(84%) came with clinically thyroid enlargement followed by pain in 7 cases (14%), 6(12%) cases presented with pressure effects like

dysphagia, dyspnoea and hoarseness of voice. 3(6%) cases presented with signs of hyperthyroidism like tremors, sweating and loss of weight. On examination (**Table - 3**) of these patients it was seen that, presence of bilateral swellings was observed in 36% cases followed by midline and right side (20%). Lesser involvement was seen in Left Lobe (8%). Total number of cases with swellings (84%) was more than cases (16%) with no swellings.

Table - 1: Distribution of patients by age (n=50).

Age Group (In Years)	No of Patients	%
11-20	3	6
21-30	10	20
31-40	21	42
41-50	12	24
51-60	3	6
61-70	1	2
Total	50	100

Table - 2: Distribution of patients by sex (n=50).

Sex	No of Patients	%
Males	15	30
Females	35	70
Total	50	100

Table - 3: Distribution of thyroid swellings by site.

Site of Swellings	No of Patients	%
Left side	4	8
Right side	10	20
Midline	10	20
Both sides	18	36
No swellings	8	16
Total number of swelling	42	84
Total cases	50	100

According to time duration, 7 months to 1 year group had maximum cases constituting for 47.6% and greater than 1.1 years group had only 9.5% of cases. **Table - 4** presents the distribution of cases according to movement of swelling on deglutition. Out of 42 thyroid

swelling cases, 85.7% of swellings showed positive movement on deglutition which is typical feature of thyroid swellings whereas 14.3% showed no movement on deglutition either due to wrong interpretation or too small size of swelling.

Table - 4: Distribution of cases according to movement of swelling on deglutition.

Movement on Deglutition	No of cases	%
Positive	36	85.7
Negative	6	14.3
Total	42	100

Table - 5: Distribution of cases according to site of lesion on USG.

Lesion site	No of cases	%
Left lobe	10	20
Right lobe	14	28
Both lobes	23	46
Isthmus	3	6
Total	50	100

Table - 6: Diagnosis based on clinical and sonographic examination in 50 patients.

Diagnosis	Clinical Examination	Sonographic Examination
Solitary Thyroid Nodule	40/50	28/50
Multinodular Disease	6/50	18/50
Other Diagnosis	4/50	4

In this study it was observed that among 42 thyroid swelling cases, most common consistency was soft in 23 cases (54.8%) followed by nodular in 10 cases (23.8%). **Table - 5** presents the distribution of cases according to site of lesion on USG. In all the cases (Table 5) bilobar involvement on USG was seen in 23 cases (46%) followed by Rt. Lobe in 14 cases (28%). Minimum number of lesions was seen in Isthmus in 3 cases (6%).

In the study, majority of lesions had hypoechoic echotexture (34%) followed by isoechoic (28%) and heterogenous (24%). Diagnosis based on

clinical and sonographic examination in 50 patients is presented in **Table - 6** while evaluating USG detected a significantly more of thyroid nodules in comparison to clinical

examination. Twelve patients with clinical diagnosis of solitary nodule were found to have multinodular disease on USG examination.

Table - 7: Distribution of patients on the basis of no. of nodules detected on USG examination.

Diagnosis	No of Patients (n=50)	No of Nodules (n=61)	%
Solitary Nodule	28	31	47.54
Multinodular Disease	18	30	52.45
Diffuse Enlargement	4	0	0

Table - 8: Distribution of benign thyroid cases according to USG diagnosis and FNAC diagnosis.

	USG diagnosis		FNAC diagnosis	
	Number of cases (n=44)	%	Number of cases (n=43)	%
Adenomatous Nodule	17	38.64	17	39.53
Multinodular Goiter	5	11.36	5	11.63
Colloid Cyst	10	22.73	10	23.25
Hashimoto's Thyroiditis	3	6.82	4	9.30
Graves Disease	3	6.82	2	4.65
Thyroglossal Cyst	2	4.54	2	4.65
Follicular Adenoma	4	9.09	3	6.98

Table - 7 presents the distribution of patients on the basis of number of nodules detected on USG examination. While examination it was seen that Solitary thyroid nodule means presence of single nodule in the thyroid gland while multinodular disease indicates presence of more than one nodule. In this study among malignant cases papillary carcinoma was most common lesion in 83.34% of cases followed by anaplastic carcinoma in 1(16.66%) case.

Graves disease in 2(4.65%) of cases and Follicular adenoma in 3(6.98%) of cases. Thyroglossal cyst was seen in 2 (4.65%) of cases.

Discussion

The thyroid gland is the first of the body's endocrine glands to develop on approximately the 24th day of gestation. The thyroid originates from two main structures: the primitive pharynx and the neural crest. The rudimentary lateral thyroid develops from neural crest cells, while the median thyroid, which forms the bulk of the gland, arises from the primitive pharynx. The thyroid gland forms as a proliferation of endodermal epithelial cells on the median surface of the developing pharyngeal floor.

Distribution of benign thyroid cases according to USG diagnosis and FNAC diagnosis is shown in **Table - 8**. In the present study, among 44 benign cases, adenomatous nodules were most common benign pathology in 38.64 % of cases followed by colloid cysts in 22.73% of cases and multinodular goiter in 11.36% of cases. 2(4.54%) cases were diagnosed as Thyroglossal cysts. Table 8 also shows that among benign thyroid cases observed on FNAC, adenomatous nodules were most common pathology in 17(39.53%) of cases followed by colloid cysts in 10(23.25%) of cases, multinodular goiter in 5(11.63%) of cases, Hashimoto's thyroiditis in 4(9.30%) of cases,

In this prospective study a detailed sonographic examination of 50 patients was done. Out of fifty patients having various thyroid ailments, majority of them were between 3rd to 5th decade (66%) with most female patients (70%) dominating the group as compared to males (30%).The youngest case in the study was a 12

years old girl and oldest case was a 70 years old male. In a previous study of 1985 patients female number was 1742 and 203 were males and most of the patients were in age group of 48 ± 15 years [10]. Similarly in another retrospective study carried in year 2009 thyroid lesions were seen in 158 cases of which 138 cases were females and 27 cases were males. Female: Male ratio was 4.7:1. Most of the cases were found in age group of 3rd to 5th decade [11].

In our study of 50 patients, forty two cases presented with clinically enlarged thyroid, either in the mid line or on the lateral aspect. 94% patients presented with gradual onset whereas 6% presented with sudden onset of thyroid swelling. Pressure effects due to thyroid swelling (Dyspnoea, Dysphagia, Hoarseness of voice) were seen in 12%, signs of thyrotoxicosis (loss of weight in spite of good appetite, insomnia, tremors, irritability, exophthalmos, menstrual irregularities, dry skin, hair loss, lethargy, hoarseness of voice, failing memory) was present in 6%, pain in 14% and fever in 8% cases. Twenty eight of these patients had solitary thyroid nodule while eighteen had multinodular thyroid disease. Four patients had no evidence of any thyroid nodule. Out of forty patients with clinical diagnosis of solitary thyroid nodule, 12 patients had multinodular disease on ultrasound examination. A previous study also showed that ultrasound can detect significantly large number of nodules in comparison to clinical examination [12]. In another study out of 73 solitary nodules 36 (48.6%) showed multiple nodules on USG. Thus, USG is a modality to know the exact number of nodules [13].

The Society of Radiologists in Ultrasound suggested that FNA should be considered for a nodule 1.0 cm or more at the largest diameter if microcalcifications are present and for a nodule 1.5 cm or larger if the nodule is solid or if there are coarse calcifications within the nodule.

Out of fifty patients, 44(88%) patients had sonographic features suggestive of benign and 6(12%) cases as malignant. Out of cases in the

benign group, one patient had features of Follicular adenoma, later turned out to be Follicular Carcinoma on histopathology. All the six malignant lesions of thyroid were confirmed on FNAC/Histopathology. Five cases were diagnosed as papillary carcinomas and one case as anaplastic carcinoma. Out of four cases of Follicular Adenoma, 1 turned out to be Follicular Carcinoma on histopathology. Similar findings have been reported by Papni, et al. and Kovacevic, et al. as well [14, 15].

Multinodular goiter is commonest pathological condition of thyroid. USG shows multiple nodules in an enlarged thyroid. It occurs due to hyperplasia with subsequent formation of nodules with associated fibrosis and calcification within nodules. Vascular compression due to follicular hyperplasia causes focal ischemia with resultant necrosis and inflammatory changes. In five cases of Multinodular Goitre in our study, all nodules were wide than tall with well-defined margins, 4(80%) cases had a well-defined regular thin peripheral halo, 3(60%) cases were solid, 1(20%) predominantly solid and 1(20%) was cystic. This is in course to a previous study where similar findings were seen [16].

The present study revealed 3 cases of Grave's disease. All three cases revealed diffusely reduced echogenicity with thyroid inferno pattern of vascularity. On FNAC only two cases were reported as Grave's disease and one was reported Hashimoto's thyroiditis. In a previous study conducted on 55 patients of hyperthyroidism, 29 cases were diagnosed as Grave's disease [17].

In the present study of 7 cases of malignant thyroid lesions, sonographic diagnosis of papillary carcinomas was made in 5(71.44%) cases subsequently confirmed on FNAC. Majority of these malignant lesions i.e., 4 (80%) cases were markedly hypoechoic and 1(20%) case showed heterogenous echogenicity. Three (60%) cases showed microcalcification and 2(40%) cases showed macrocalcification. 4(80%) cases had ill-defined margins and 1(20%) case had well defined margins. 3(60%) cases showed

solid echotexture while 2(40%) cases were predominantly solid. In all cases nodules were tall than wide with absent halo in 4 (80%) cases and 1(20%) case showing thin peripheral regular halo. Cervical lymphadenopathy was seen in all cases with partially necrotic nodes and foci of microcalcification. Solbiati, et al. also concluded that malignant thyroid masses have predominantly hypoechoic echopattern which was similar to the findings of the present study [18].

Conclusion

The study concluded that high resolution ultrasound should be performed in all patients presenting with clinical thyroid swelling or symptoms related to thyroid disorders. USG can detect and characterize the thyroid nodules better than any other imaging modality and a system can be devised for differentiating benign from malignant thyroid nodules and diffuse from focal thyroid diseases, where in sonographically benign nodules should be followed up by ultrasound and FNAC/FNAB should be performed only in nodules which are indeterminate or malignant on ultrasound. Awareness of these findings would result in improved patient care, reduction in unnecessary surgical procedures with consequent reduction of patient morbidity and healthcare cost.

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