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ROLE OF ULTRASOUND IN THE EVALUATION OF THYROID SWELLINGS

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Abstract

Introduction: Thyroid gland plays a critical role in regulating metabolic functions such as cardiac rate and output, lipid catabolism, skeletal growth and heat production. Thyroid swelling is one of the common clinical problems routinely encountered in the out-patient department. Most of them are due to diffuse enlargement of thyroid gland (diffuse colloid goiter) commonly seen at puberty, lactation etc. Other pathological lesions such as thyroid neoplasms also present in the form of enlarged thyroid mass or thyroid nodule.

Materials and Methods: This study was conducted in the Department of Radiodiagnosis, Narayana Medical College & Hospital, Nellore, during the period of Jan 2007 to Oct 2008. Ultrasound scan is performed with PHILIPS Envisor C machine using a linear probe of 3-12MHz frequency. The Study included 60 patients who presented with a swelling in front of the neck (near the region of thyroid). Longitudinal and transverse scans of the thyroid gland were done with the patient in supine position and head in hyper-extension. The entire gland including the isthmus was examined. The examination has also been extended laterally to include the region of the carotid artery and the jugular vein in order to identify enlarged jugular chain lymph nodes, superiorly to visualize submandibular adenopathy and inferiorly to define any supraclavicular lymphadenopathy.

Results: This study includes a total of 60 patients presenting with a palpable thyroid mass, referred to department of radiology from the departments of Surgery, Medicine and ENT. Differentiation of a mass lesion into cystic, solid or mixed is important application of US evaluation of thyroid. Out of 60 patients, 8 cases were cystic, 32 were solid and 20 cases were mixed lesions which were proved to be correct (100% accurate).

Conclusion: Ultrasound is a cost-effective, non-invasive, easily accessible and valuable diagnostic tool with good sensitivity and specificity. Ultrasound is complimentary to other diagnostic methods in thyroid lesions. Ultrasound can demonstrate the number of nodules,

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whether solitary or multiple nodules in a goiter. Ultrasound can demonstrate various secondary degenerative changes in thyroid lesions namely, cystic changes, calcifications, haemorrhages etc. Ultrasound is helpful in differentiating benign from malignant lesions.

Key Words: Thyroid gland, lipid catabolism, thyroid mass, Ultrasound.

INTRODUCTION

Thyroid gland plays a critical role in regulating metabolic functions such as cardiac rate and output, lipid catabolism, skeletal growth and heat production. Thyroid swelling is one of the common clinical problems routinely encountered in the out-patient department.[1] Most of them are due to diffuse enlargement of thyroid gland (diffuse colloid goiter) commonly seen at puberty, lactation etc. Other pathological lesions such as thyroid neoplasms also present in the form of enlarged thyroid mass or thyroid nodule.[2] Various immunological diseases of the thyroid including hypo and hyper thyroid states may present as thyroid enlargement. Clinical evaluation of the thyroid is not always conclusive. Hence, the clinician has to depend on various other diagnostic modalities such as ultrasonography, FNAC etc. to achieve a definitive diagnosis.[3]

Advantages of ultrasonography over clinical examination:

1. Ultrasonography provides a better anatomical representation of the Thyroid gland with remarkable clarity due to the superficial location of the gland.
2. It can reveal the nature of the mass (cystic vs. solid).
3. Ultrasound can reveal the number of nodules i.e. whether the lesion is a solitary nodule or is it a palpable nodule that is a part of multinodular goiter.
4. Ultrasound is helpful in detecting calcification and the pattern of calcification.
5. Ultrasound is helpful in assessing the vascularity of the lesion.
6. Invasion of the adjacent structures by the thyroid mass can be known by ultrasonography.
7. Lymph node status is better evaluated with ultrasound.

AIMS AND OBJECTIVES

1. To study Thyroid swellings sonographically presenting to our hospital.

2. To study the role of Ultrasound in differentiating benign from malignant lesions.

CLASSIFICATION OF THYROID DISEASES

1.CONGENITAL

Agenesis or hemiagenesis.

Hypoplasia.

Ectopia.

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2. ACQUIRED

Hyperplastic : Diffuse.

Solitary nodule.

Multinodular.

Adenomas : Follicular.

Non-folliclar.

Malignant neoplasms : Follicular carcinoma.

Papillary carcinoma.

Medullary carcinoma

Anaplastic carcinoma.

Lymphoma, sarcoma, teratoma etc.

Thyroiditis: Acute - Non-specific.

Sub-acute - Hashimoto's.

Chronic - Atrophic.

MATERIAL AND METHODS

This study was conducted in the Department of Radiodiagnosis, Narayana Medical College & Hospital, Nellore, during the period of Jan 2007 to Oct 2008.

Ultrasound scan is performed with PHILIPS Envisor C machine using a linear probe of 3-12MHz frequency.

The Study included 60 patients who presented with a swelling in front of the neck (near the region of thyroid).

Longitudinal and transverse scans of the thyroid gland were done with the patient in supine position and head in hyper-extension. The entire gland including the isthmus was examined. The examination has also been extended laterally to include the region of the carotid artery and the jugular vein in order to identify enlarged jugular chain lymph nodes, superiorly to visualize submandibular adenopathy and inferiorly to define any supraclavicular lymphadenopathy.

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RESULTS

Table 1: **Incidence of Different Types of Lesions on Sonography**

Type of lesion on sonographic examination	No. of cases
Cystic	8
Solid	32
Mixed	20
Total	**60**

Table 2: Sonographic features of different types of cystic lesions

Sonographic Feature	Colloid goiter with cystic degeneration	Haemorrhagic cyst	Cystic papillary carcinoma
Shape			
Round	3	-	-
Oval	3	1	-
Irregular	-	-	1
Margins			
Regular	6	1	-
Irregular	-	-	1
Echotexture			
Echofree	6	1	1
Echo poor	-	-	-
Homogeneity			
Homogenous	4	-	-
Heterogenous	2	1	1
Calcification	-	-	1
Intracystic septation	2	-	-
Hypoechoic HALO	-	-	-
Total	**6**	**1**	**1**

Table 3: Sonographic features of different types of solid lesions

Sonographic feature	Colloid goiter	Follicular adenoma	Papillary Carcinoma	Hashimoto's thyroiditis
Shape				
Round	2	4	-	
Oval	6	-	-	Diffuse
Irregular	-	-	1	

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Margins				
Regular	8	4	-	19
Irregular	-	-	1	-
Echotexture				
Isoechoic	4	4	-	8
Hypoechoic	-	-	1	11
Hyperechoic	4	-	-	-
Homogenicity				
Homogenous	8	4	-	15
Heterogenous	-	-	1	4
Calcification	4	-	1	-
Hypoechoic halo	6	1	-	-
Lymphadenopathy	-	-	1	-
Distant metastasis	-	-	-	-

Table 4: Nature of the solid thyroid lesions

Solid lesion	Hyperechoic	Hypoechoic	Isoechoic
Colloid goiter	4	0	4
Follicular adenoma	0	0	4
Papillary carcinoma	0	1	0
Hashimoto's thyroiditis	0	11	8
Total	**5**	**11**	**16**

Table 5: Sonographic features of various mixed lesions

Sonographic feature	Colloid goiter with cystic degeneration	Follicular adenoma	Papillary Carcinoma
Shape			
Round	8	-	-
Oval	7	2	-
Irregular	2	-	1

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Margins Regular Irregular	 13 4	 2 -	 - 1
Echotexture Mixed echotexture	 17	 2	 1
Homogenicity Homogenous Heterogenous	 - 17	 - 2	 - 1
Calcification	6	-	1
Hypoechoic halo	8	1	-
Lymphadenopathy	-	-	1
Distant metastasis	-	-	-

Table 6: incidence of calcification found with the lesion

Lesion	No. of cases	No. of cases showing Calcification
Colloid goiter	31	10 (32.25%)
Follicular adenoma	6	0 (0%)
Papillary carcinoma	3	3 (100%)

Table 7: Hypoechoic Halo in Various Thyroid Lesions

Lesion	No. of cases	Incidence of hypoechoic rim
Colloid goiter	31	14 (45.16%)
Follicular adenoma	6	2 (33.33%)

DISCUSSION

Thyroid disorders presenting as swellings constitute a significant number of cases. Although thyroid is a superficial gland easily accessible to physical examination, but it needs various biochemical, radiological and histopathological investigations to confirm the diagnosis.

This study includes a total of 60 patients presenting with a palpable thyroid mass, referred to department of radiology from the departments of Surgery, Medicine and ENT.

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Nature of the Lesion: Differentiation of a mass lesion into cystic, solid or mixed is important application of US evaluation of thyroid. Out of 60 patients, 8 cases were cystic, 32 were solid and 20 cases were mixed lesions which were proved to be correct (100% accurate).

In a study by Rosen IB *et al*[(1)], out of 174 cases, an accuracy rate of 96% was observed. Our accuracy of 100%.

Cystic Lesions: We encountered 3 types of cystic lesions namely colloid goiter with cystic degeneration, cystic papillary carcinoma and the hemorrhagic cyst. Out of these, majority of the cases were constituted by colloid goiter with cystic degeneration. There were 8 cases presenting with cystic lesions and 6 cases were diagnosed as colloid goiter with cystic degeneration, 1 case as cystic papillary carcinoma and 1 case as hemorrhagic cyst.

Rosen IB *et al* [(1)] reported their study in which they found 13% malignancies in cystic lesions. No simple thyroid cyst was encountered in our study in contrary to the study reported by Simeone JF *et al* [(2)] where they found 1 simple cyst out of 116 cases of thyroid nodules.

Watters DA([(3)] conducted study in 120 patients with thyroid nodules and found cystic elements in 26% of malignant lesions. Chan BK*et al* [(4)] retrospectively analysed 55 patients with proven papillary carcinoma of thyroid and found that cystic carcinomas were rare and accounted for only 6% of the lesions.
Rosario PWS*et al* [(5)] have studied 106 thyroid nodules confirmed to be papillary carcinoma after total thyroidectomy and found cystic components in 10.3% of the cases. Wunderbaldinger P*et al* [(6)]have sonographically examined 74 patients with 97 histologically confirmed cystic lymph node metastases from papillary carcinoma of thyroid ipsilateral to primary tumor (87.8%), mid or lower jugular chain (73.2%). Solbiati L *et al*[(3)] found 26(6%) cystic lesions out of 401 cases. None of these were malignant lesions. Our findings are consistent with their findings.

Solid Lesions:

We encountered 32 (53.33%) solid lesions in our study. Among the solid lesions, 19 cases (59.4%) were sonographically diagnosed as Hashimoto's thyroiditis, 8 cases (25%) as colloid goiters, 4 cases (12.5%) as follicular adenoma and 1 case (3.1%) as papillary carcinoma.
Rosen IB *et al*[(1)] reported 100% accuracy rate for solid lesions. They studied 174 cases out of which 130 (75%) were solid both by sonography as well as FNAC. Out of these 130 cases 26 (20%) were carcinomas, 68 (52%) were adenomas, 2 (1.5%) were cystadenoma, 16 (12.5%) were colloid nodule, 7 (5.3%) were thyroiditis and 11 (8.5%) were diagnosed as goiter. Simeone JF *et al*[(51)] studied 116 cases and they found 99 (85%) cases as solid lesions out of which 66 were follicular adenoma, 21 were goiter and 12 were Hashimoto's thyroiditis. Solbiati L *et al* [(7)] studied 430 thyroid nodules out of which 351(81.6%) were solid nodules. Out of these 65 (18.5%) were goiters, 133 (37.8%) carcinomas and 153 (43.5%) were diagnosed as adenomas. Cox MR *et al*[(8)] have performed ultrasonographic examination of 68 cases of thyroid nodules and they found 18 (26.5%) of them as solid nodules, 3 (17%) of the 18 cases were found to have a malignant thyroid nodules. Consorti F *et al*[(9)] studied 196

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patients out of which 33 cases were found to be malignant, 9 cases as follicular adenomas and 154 cases as colloid goiters.

In our study, out of 32 cases presenting with solid thyroid nodules, 8 cases were diagnosed as colloid goiters (4 were isoechoic and 4 were hyperechoic); 4 cases were diagnosed as folliclar adenoma (all of them were isoechoic); 19 cases were diagnosed as Hashimoto's thyroiditis (11 were hypoechoic and 8 were isoechoic); 1 case was diagnosed as papillary carcinoma which presented as hypoechoic lesion.

Solbiati L *et al* [7] studied 351 solid thyroid nodules, out of which 74 were hyperechoic, 119 were isoechoic and 158 presented as hypoechoic nodules. 74 hyperechoic nodules comprised of 22 (30%) goiter, 49 (66%) adenoma and 3 (4%) were malignancy. Of the 119 isoechoic nodules, 35 (29%) were goiter, 53 (45%) were adenomas, 31 (26%) were malignant. Of the 158 hypoechoic nodules 8 (5%) were goiters, 51 (32%) were adenomas and 99 (63%) were malignant lesions.

Mixed Lesions:

We encountered 20 cases of mixed (both solid and cystic) lesions in our study group. 17 cases were diagnosed as colloid goiter with cystic degeneration, 2 cases of follicular adenoma and 1 case of Papillary carcinoma. In our study among mixed lesions, the diagnostic yield was 100%.

Rosen IB *et al*[1] in a study of 174 patients, found 14 cases of mixed echotexture nodules by ultrasound evaluation. 4 cases of mixed lesions were falsely diagnosed as cystic and solid lesions by ultrasound which lated proved to be of mixed echotexture. Solbiati L *et a*l [7] found that out of 430 lesions studied by them, 53 were mixed echotexture masses. Out of these 53 cases, 28 (53%) were goiter, 19 (36%) were adenoma and 6 (11%) were malignancies.

Calcification:

Calcification within the lesion is very important for characterizing a lesion. In our study we found 2 types of lesions in which calcification was present. Out of 31 cases of colloid goiters, 10 cases (32.25%) were showing calcification. All the 3 cases of papillary carcinoma (100%) showed calcifications. The incidence of calcification in benign thyroid lesions was 17.54 %(10 out of 57) and in malignant lesions it was 100% (3 out of 3).

In the study of Solbiati L *et al* [7] the incidence of calcification in benign thyroid lesions was 11% and in malignant lesions it was 17%.

Watters DA *et al*[3] have reported calcifications in 37% of malignancies and there was cystic component in 26% of the malignancies. Rosario PWS *et* [5] studied 84 patients (106 nodules) and observed micro calcifications in 26.4% and cystic components in 10.3%.Chan BK *et al*[4] reported ultrasonography findings of 55 patients with papillary carcinoma and found micro calcifications in 42% and hyper vascularity in 69%. We observed hyper vascularity in 66.6% and micro calcifications in all the 3 cases.

Study by Kim EK *et al*[10] found micro calcifications in 59% of malignant nodules where as only 14.2% of benign nodules had micro calcifications. Takashima S et al [11] found that out of the various sonographic signs, micro calcifications showed the highest accuracy (76%), specificity (93%) and positive predictive value (70%) for malignancy as a single sonographic sign.

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Kakkos SK *et al* [12] conducted a study on 188 patients with thyroid disease and found the highest incidence of calcification in thyroid cancer (54%) followed by multinodular goiters (40%). Consorti F *et al*[9]found that out of 196 patients, calcifications were more common in differentiated thyroid carcinoma (39.4%) than in adenoma (11.1%) and goiter (20.1%).
Seiberling KA *et al* [13)] conducted study on 159 patients out of which 66 patients of cancer 52 (78.8%) had calcifications 93 patients with benign pathology, only 36 (38.7%) had calcifications.
Taki S *et al*[14] studied 101 patients with a total of 151 thyroid nodules in which calcifications were seen in 57 (38%) nodules. Iannucilli JD *et al*[15] retrospectively analyzed the sonographic features of 34 malignant and 36 benign thyroid nodules and found that intrinsic calcification was the only statistically significant predictor of malignancy ($p < 0.005$).

Hypoechoic Halo:

Presence and nature of hypoechoic halo is one of the important feature that helps in differentiating benign from malignant lesion.
In our study, 16 cases (26.7%) presented with halo, all of which were benign. Out of these, colloid goiter constituted the maximum (87.5%) followed by follicular adenoma (12.5%).
Propper RA *et al*[16] conducted a study on 28 patients with solitary thyroid masses out of which 10 patients had hypoechoic halo. 8 of these lesions were benign Twolesions were malignant. Solbiati L *et al*[7] concluded in their study that a peripheral sonolucent halo surrounding a thyroid nodule may be present in 60-80% of benign nodules and 15% of thyroid cancers.

Micronodulation:

Micronodulation is highly diagnostic of Hashimoto's thyroiditis confirmed by Yeh HC *et al*[17] the positive predictive value is 94.7%.

Benign Vs Malignant:

Most of the cystic lesions are benign in nature96.87 % of solid lesions were benign and rests were malignant. Among mixed lesions 95%were benign and rests were malignant. Total benign lesions constitute 95 %(57 out of 60) and malignant lesions constitute 5 %(3 out of 60).

In study out of 60 patients 8 cases of colloid goiters out of which 6 cases (75%) were proved to be correct two cases were proved to be follicular adenoma. Sonographic misinterpretation was the cause.
23 cases (100%) of colloid goiter with cystic degeneration proved to be correct 3 cases (100%) of papillary carcinoma of thyroid were proved to be correct. Six cases of follicular adenoma were diagnosed and were proved to be correct 19 cases of Hashimoto's thyroiditis and all of them were proved to be correct.In our study of sonographic examination of thyroid lesions yields an accuracy rate of 96.67%.
Rosen IB *et al*[1] found 96% accuracy.
Jones AJ *et al* [18] found 75% sensitivity rate with 61% specificity and 19% positive predictive value. Watters DA *et al*[3] found sensitivity rate of 74%, specificity 85% and positive predictive value of 51%.

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CONCLUSION

Ultrasound is a cost-effective, non-invasive, easily accessible and valuable diagnostic tool with good sensitivity and specificity. Ultrasound is complimentary to other diagnostic methods in thyroid lesions. Ultrasound can demonstrate the number of nodules, whether solitary or multiple nodules in a goiter. Ultrasound can demonstrate various secondary degenerative changes in thyroid lesions namely, cystic changes, calcifications, haemorrhages etc. Ultrasound is helpful in differentiating benign from malignant lesions.

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