ORIGINAL RESEARCH ARTICLE

Role of Ultrasound in the Evaluation of Thyroid Swelings – A Study

M. Gayatri[1], S. Rajesh Kumar[2], S.V. Phanindra[3], T.M. Sucharitha[4]

[1]Associate Professor of Radiology, [2]Associate Professor of ENT, [3]Professor & HOD, Forensic Medicine & Toxicology, [4]Associate Professor of Anatomy, Narayana Medical College, Chinthareddypalem, Nellore, Andhra Pradesh-524003, India

Corresponding author: Dr. S. Rajesh Kumar, H-No-24/170/1, Near Little Angels School, Mulapet, Nellore-524003, Andhrapradesh, India

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A B S T R A C T

Introduction: Thyroid swellings are quite common, and their differential diagnosis plays a vital role in the proper management. Absolute diagnosis at a cost-effective method is required for the benefit of the patient. This study focuses on the role of Ultrasound in diagnosing thyroid swellings. Objective: To study the role of ultrasonography in diagnosing lesions of the thyroid gland.

Material and methods: This Ultrasound study was conducted in the Department of Radiodiagnosis, Narayana Medical College & Hospital, Nellore, using PHILIPS Envisor C machine with a linear probe of 3-12MHz frequency from Jan 2007 to Oct 2008 involving 60 patients who presented with a swelling in front of the neck (near the region of the thyroid). Summary: Based on the sonographic findings and various sonographic parameters, lesions were differentiated into cystic, solid, and mixed lesions. Out of 60 patients, 8 cases (13.3%) were diagnosed as cystic, 32 cases (53.3%) as solid, and 20 cases (33.3%) were mixed lesions. Diagnostic accuracy in this series was 100%. Out of 8 cases of cystic lesions, 6 were colloid goiter with cystic degeneration, one case of hemorrhagic cyst one case of cystic papillary carcinoma, with an accuracy of 100%.

Among 32 solid lesions, four types of lesions were made out Sonographically, 1 case of papillary carcinoma and 19 cases of Hashimoto's thyroiditis. Out of 8 cases of colloid goiter, six were proved to be correct. Our accuracy among solid lesions was 93.7%. Out of 20 mixed (both solid and cystic) lesions, colloid goiters with cystic degeneration (17 cases), follicular adenoma (2 cases), and papillary carcinoma (1 case). The diagnostic accuracy was 100%. The incidence of calcification for papillary carcinoma is 100% (3 out of 3 cases), 32.25 % for colloid goiter (10 out of 31 cases). Incidence of hypoechoic "halo" in colloid goiter was 45.16% (14 out of 31 cases), and in follicular adenoma, it was 33.3% (2 out of 6 cases). Our sonological evaluation of thyroid lesions for categorizing a lesion as cystic, solid, or mixed was 100% accurate, and the Sonographic diagnostic accuracy of thyroid lesions was 96.7% in our series.

Keywords: Benign, Malignant, Cystic, Nodular

INTRODUCTION

The thyroid gland plays a critical role in regulating metabolic functions such as cardiac rate, cardiac 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 the thyroid gland (diffuse colloid goiter) commonly seen at puberty, lactation, etc. Other pathological lesions, such as thyroid neoplasms, also present as enlarged thyroid mass or a thyroid nodule. Various immunological diseases of the thyroid, including hypo, and hyperthyroid states, may present as thyroid enlargement. Clinical evaluation of the thyroid is not always conclusive. Hence, the clinician needs to depend on various other diagnostic modalities such as ultrasonography, FNAC, etc., to achieve a definitive diagnosis.

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). 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 helps to detect calcification and the pattern of calcification.
5. Ultrasound helps to assess the vascularity of the lesion.
6. Invasion of the adjacent structures by the thyroid mass can be known
7. Lymph node status is better evaluated with Ultrasound.

Objectives

To study the role of ultrasonography in diagnosing lesions of the thyroid gland.

MATERIAL AND METHODS

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

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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 (in the thyroid region).
Longitudinal and transverse scans of the thyroid gland were done with the patient in the 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 carotid artery and the jugular vein to identify the enlarged jugular chain of lymph nodes. Superiorly to visualize submandibular lymphadenopathy, and also inferiorly to define any supraclavicular lymphadenopathy.

STATISTICAL ANALYSIS

This study includes 60 patients presenting with a palpable thyroid mass, referred to the radiology department from Surgery, Medicine, and ENT departments.
The findings are tabulated according to the nature of lesions like cystic, solid, and mixed, characters like calcification, hypoechoic halo,micronodulation, , and benign vs. malignant.

DISCUSSION

The Thyroid lesions are discussed and compared to similar studies

Nature of the lesion (Table-1)
Differentiation of a mass lesion into cystic, solid, or mixed is an essential Ultrasound evaluation of the thyroid. Out of 60 patients, 8 cases were cystic, 32 were solid, and 20 were mixed lesions, and 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 is about 100%.

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

Table-1: Incidence of different types of lesions on sonography

Cystic lesions (Table-2)
We encountered three types of cystic lesions: colloid goiter with cystic degeneration, cystic papillary carcinoma, and hemorrhagic cyst. Out of these, the majority of the cases were constituted by colloid goiter with cystic degeneration. Eight cases were presented with cystic lesions, and 6 cases were diagnosed as colloid goiter with cystic degeneration, 1 case as cystic papillary carcinoma, and 1 case as a 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, contrary to the study reported by Simeone JF et al.. [2], where they found one simple cyst out of 116 cases of thyroid nodules.
Watters DA([3] conducted a study in 120 patients with thyroid nodules and found cystic elements in 26% of malignant lesions. Chan BK et al. [4] retrospectively analyzed 55 patients with proven papillary carcinoma of the 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 histologically confirmed cystic lymph node metastases from papillary carcinoma of the thyroid to the same side of the primary tumor (87.8%) and to the 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 (Table-3)
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 a 100% accuracy rate for solid lesions. They studied 174 cases, out of which 130 (75%) were solid both by sonography and FNAC. Out of these 130

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
Echo texture			
Echo free	6	1	1
Echo poor	-	-	-
Homogeneity			
Homogenous	4	-	-
Heterogenous	2	1	1
Calcification	-	-	1
Intracystic septation	2	-	-
Hypoechoic HALO	-	-	-
Total	6	1	1

Table-2: Sonographic features of different types of cystic lesions

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 an 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 nodule. Consorti F et al. [9] studied 196 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 four were hyperechoic); 4 cases were diagnosed as the follicular adenoma (all of them were isoechoic); 19 cases were diagnosed as Hashimoto's thyroiditis (11 were hypoechoic, and eight were isoechoic) and 1 case was diagnosed as papillary carcinoma which presented as the 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. Seventy-four 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 (Table-4)

We encountered 20 cases of mixed (both solid and cystic) lesions in our study group. Seventeen cases were diagnosed as colloid goiter with cystic degeneration, 2 cases of follicular

Sonographic Feature	Colloid goiter	Follicular Adenoma	Papillary Carcinoma	Hashimoto's thyroiditis
Shape				
Round	2	4	-	
Oval	6	-	-	Diffuse
Irregular	-	-	1	
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-3: Sonographic features of different types of solid lesions

Sonographic Feature	Colloid goiter with cystic degeneration	Follicular adenoma	Papillary Carcinoma
Shape			
Round	8	-	-
Oval	7	2	-
Irregular	2	-	1
Margins			
Regular	13	2	-
Irregular	4	-	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-4: Sonographic features of various mixed lesions

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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 later proved to be of mixed echotexture. Solbiati L et al. [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 (Table-5)

Calcification within the lesion is significant for characterizing a lesion. In our study, we found two 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 a cystic component in 26% of the malignancies. Rosario PWS et [5] studied 84 patients (106 nodules) and observed microcalcifications in 26.4% and cystic components in 10.3%. Chan BK et al.[4] reported microcalcifications in 42% and hypervascularity in 69% of cases. In the ultrasonography findings of 55 patients with papillary carcinoma. We observed hypervascularity in 66.6% and microcalcifications in all the 3 cases.

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

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. Lannucilli 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 (Table-6)

The presence and nature of hypoechoic halo are important features that help differentiate benign from the 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 the follicular adenoma (12.5%).

Propper RA et al. [16] conducted a study on 28 patients with solitary thyroid masses, out of which ten patients had the hypoechoic halo. Eight of these lesions were benign. Two lesions were malignant. Solbiati L et al. [7] concluded in their study that a peripheral sonolucent halo surrounding a thyroid nodule might 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%.

In our study, 19 cases (31.67%) were diagnosed with Hashimoto's thyroiditis.

Benign vs. malignant

Most cystic lesions are benign in nature 96.87 % of solid lesions were benign, and rests were malignant. Among mixed lesions 95%were benign, and the others were malignant. Total benign lesions constitute 95 %(57 out of 60), and malignant lesions constitute 5 %(3 out of 60).

In our 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 the follicular adenoma. Sonographic misinterpretation was the cause.

Twenty-three cases (100%) of colloid goiter with cystic degeneration proved to be correct 3 cases (100%) of papillary carcinoma of the thyroid were proved to be correct. Six cases of follicular adenoma were diagnosed and were proved to be right 19 cases of Hashimoto's thyroiditis, and all of them were

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-5: Incidence of calcification found with the lesion

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

Table-6: Hypoechoic halo in various thyroid lesions

proved to be correct. In our study of sonographic examination of thyroid, lesions yield an accuracy rate of 96.67%.
Rosen IB et al.[1] found 96% accuracy.
Jones AJ et al. [18] found a 75% sensitivity rate with 61% specificity and 19% positive predictive value. Watters DA et al.[3] found a sensitivity rate of 74%, specificity 85%, and positive predictive value of 51%.

SUMMARY

The present prospective study consists of 60 patients ranged from 11 to 70 years.
Based on sonographic findings and various sonographic parameters, lesions were first differentiated into cystic, solid, and mixed lesions.
Out of 60 patients, 8 cases (13.3%) were diagnosed as cystic, 32 cases (53.3%) as solid, and 20 cases (33.3%) were mixed lesions. Diagnostic accuracy in this series was 100%.
Out of 8 cases of cystic lesions, 6 were colloid goiter with cystic degeneration, one case of hemorrhagic cyst one case of cystic papillary carcinoma. Our yield was 100%.
Among 32 solid lesions, four types of lesions were made out Sonographically, 1 case of papillary carcinoma and 19 cases of Hashimoto's thyroiditis. Out of 8 cases of colloid goiter, six were proved to be correct. Our yield among solid lesions was 93.7%.
Out of 20 mixed (both solid and cystic) lesions, colloid goiters with cystic degeneration (17 cases), follicular adenoma (2 cases), and papillary carcinoma (1 case). The diagnostic yield was 100%.
The incidence of calcification for papillary carcinoma is 100% (3 out of 3 cases), 32.25 % for colloid goiter (10 out of 31 cases).
Incidence of hypoechoic "halo" in colloid goiter was 45.16% (14 out of 31 cases), and in follicular adenoma, it was 33.3% (2 out of 6 cases).
Our sonological evaluation of thyroid lesions for categorizing a lesion as cystic, solid, or mixed was 100% accurate. The Sonographic diagnostic accuracy of thyroid lesions was 96.7% in our series.

CONCLUSIONS

- Ultrasound is a cost-effective, non-invasive, easily accessible, and valuable diagnostic tool with good sensitivity and specificity.
- Ultrasound is complementary 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, hemorrhages, etc.
- Ultrasound helps differentiate benign from malignant lesions.

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