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Efficacy of High Resolution Sonography in Evaluation of Thyroid Lesions - Correlation and Comparison with Histopathology

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ABSTRACT

A large spectrum of pathologic entities including benign and malignant lesions is found in the thyroid gland. Lesions of thyroid gland represent some of the most heterogeneous abnormalities in the head and neck. The purpose of this study was to detect thyroid lesions and to differentiate between benign and malignant pathology, based on their sonographic appearance. We evaluated 90 patients with thyroid swelling using high resolution sonography and color Doppler and followed up with HPE. The present study had a sensitivity of 66.6%, specificity of 96.7% and diagnostic accuracy of 91%. The sensitivity and specificity of ultrasonography in various other studies range from 60-75% and 59-91% respectively. Such wide variation in predictive values is usually attributed to the fact of ultrasonography being highly operator dependent. High resolution sonography performed by a skilled radiologist is very sensitive and is recommended as the primary imaging modality in evaluation of thyroid diseases. It has a high sensitivity and specificity in the diagnosis of thyroid diseases. Sonography examination can be regarded as an excellent investigation for differentiating solid, cystic and mixed lesions; for locating clinically non palpable nodules and for follow up of benign thyroid nodules.
Keywords: Thyroid, Nodules, High resolution, Ultrasonography

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INTRODUCTION

A wide -spectrum of pathologic entities including benign and malignant lesions are found in the thyroid gland. Lesions of thyroid gland represent some of the most heterogeneous abnormalities in the head and the neck. Clinical examination often fails to distinguish benign from malignant lesions. To assist the clinician faced with diagnostic dilemma, thyroid imaging has a well defined role. The thyroid can be imaged with multiple modalities including high resolution ultrasonography (USG), nuclear medicine technique, thin section of computed tomography (CT) *&* magnetic resonance imaging (MRI) [1]. High frequency ultrasonography can demonstrate thyroid abnormalities with remarkable clarity. It provides more information on the morphology of the gland than any other modality [2]. High resolution USG, a relatively inexpensive, widely available and non invasive method of investigation, can precisely define the morphology of thyroid lesions and detect even 1- 3 mm lesions that are not demonstrable by other means. Colour Doppler sonography has helped in the differentiation of benign and malignant thyroid lesions. Absence of increased vascularity seems to be an important parameter for the exclusion of autonomous adenoma and thyroid carcinoma. Computed Tomography has the advantage of allowing evaluation of retro tracheal and retro sternal extension of thyroid. It also helps in detection of aberrant thyroid in the neck or chest; and invasion or spread of tumor to adjacent structures in the neck. However, streak artifacts from shoulder girdle, need for contrast administration and exposure to radiation are undesirable features. Magnetic Resonance Imaging (MRI) provides excellent spatial and contrast resolution of the thyroid and neck lesions. MRI is useful for assessment of retrosternal and retro tracheal goiters, local invasion of thyroid masses and identifications of recurrence of thyroid carcinoma. It is probably less specific than sonography for establishing cystic nature of a nodule. Radionuclide studies have for many years been the most commonly used imaging method in the evaluation of nodular abnormalities of thyroid gland with iodine 123 scintigraphy, being the imaging standard for thyroid functional assessment [3]. Imaging with iodine 123 has limited spatial resolution, requires two to three sittings and it is subject to the effects of diet and medications apart from radiation exposure. 99mTc Pertechnetate and pinhole Collimator are used for anatomic thyroid evaluation.

MATERIALS AND METHODS

The study was conducted in the Department of Radiodiagnosis at Sree Balaji Medical College and Hospital between April 2011 and May 2012. The study group comprised of 90 patients with thyroid swelling. Patients with palpable abnormality of thyroid, thyroid hormonal imbalance and those with clinical suspicion of thyroid lesion in the absence of any palpable abnormality or hormonal imbalance were included in the study. Brief clinical examination was carried out in all patients. Thyroid profile was evaluated in all the cases. Radiological evaluation consisted of high resolution USG and color Doppler in all patients. High resolution USG was carried out on GE LOGIQ PRO 5 machine using 7-10 MHz linear transducer. Sonographic evaluation of thyroid was performed with the patient in the supine position, with hyperextension of the neck obtained by a pad placed under the shoulders. Additional scanning was done during swallowing to evaluate mobility of thyroid and possible retrosternal thyroid. Scanning was performed in longitudinal and transverse planes, for a preliminary evaluation of the thyroid size, its relationship with adjacent structures and assessment of the nodal chains of the neck. Detailed evaluation assessed dimensions of both lobes and isthmus of thyroid for diffuse or focal involvement. Focal abnormality was classified as solitary/ multiple nodules. According to the echotexture, the lesion was classified as hypoechoic / isoechoic / hyperechoic/ heteroechoic / anechoic. Images were assessed for presence or absence of halo around the lesion and its width, regularity and completeness. The lesion was assessed for margins of the lesions, presence or absence of calcification and cystic degeneration. Retro tracheal or retrosternal extension of thyroid mass was assessed along with any lymphadenopathy, muscle or tracheal infiltration and involvement of carotid vessels and internal jugular vein. Thyroid gland vascularity was evaluated for absent vascularity, low velocity flow, high velocity flow and thyroid inferno. In case of nodular lesions, the lesion was assessed for perinodular increased vascularity, intranodular vascularity or absent vascularity. After evaluating the lesion by ultrasound fine needle biopsy was obtained from the solid element of the lesion under ultrasound guidance.

OBSERVATIONS AND RESULTS

Of the 90 patients with clinically suspected thyroid disease, evaluated by high resolution sonography and pathological correlation most were in the age group of 31-40 yrs. There was only one patient above 60 yrs.

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Significant female preponderance was noted in the group with females constituting 86.8% and males constituting 13.2%. Table 1 demonstrates the distribution of all pathologies by USG findings.

Table 1: DISTRIBUTION OF ALL PATHOLOGIES BY USG FINDINGS

Age group	No. cases
COLLOID GOITRE	48
BENIGN NODULE	9
MULTINODULAR GOITER	17
THYROIDITIS	9
MALIGNANCY	6
THYROID CYST	1
TOTAL	90

The commonest thyroid pathology encountered in the study was colloid goiter (53%). Most of the cases were heteroechoic in pattern followed by isoechoic appearance. Most of the colloid nodules had cystic degeneration Coarse calcification was seen only in 11%. A thin halo was seen in 27 patients (55%). Micro calcification and rim calcification was not seen in any cases.

Table 2: Colloid goiter

Radiological diagnosis	**FNAC**	**HPE**	
		Benign	Malignant
48	48	18	1 Papillary Ca

All the colloid goiters diagnosed by USG, turned out to be same on FNAC [Table 2]. HPE was available for only 19 cases which showed benign nodule in 18 and 1 case turned out to be papillary carcinoma [Figure 1]. It had hypoechoic pattern with cystic changes, which suggested colloid goiter. However, papillary carcinomas may also rarely exhibit varying amount of cystic changes and appears almost indistinguishable from benign cystic nodules. This accounted for a false negative case in this study. The sonographic features of colloid goiter are summarized in Table 3.

Figure 1: Large predominantly cystic nodule in the left lobe giving a sonographic appearance of colloid goitre. HPE though confirmed this to be a cystic papillary carcinoma thyroid.

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Table 3: Sonographic features of colloid goiter

S.No.	Appearance	No. of cases	%
1.	Solid	4	8.3
2.	Mixed	32	66.6
3.	Predominantly cystic	5	10.4
4.	Entirely cystic	7	14.5

Multinodular goiter [Figure 2] comprised the second largest group (18.8%) of total cases. Of all the patients only seven had HPE which revealed multinodular goiter in all cases [Table 4].

Figure 2: Shows multiple nodules of varying sizes and echotexture, sonographically suggestive of multinodular goitre

Table 4: Multinodular goiter

Radiological diagnosis	FNAC	HPE	
		Benign	Malignant
17	**17**	7	0

Nine cases were diagnosed as benign nodule and it included follicular adenoma, hyperplastic nodule and adenomatous nodule [Table 5]. Of these patients, only 5 patients had HPE which revealed benign adenomatous goiter [Figure 3] in four, and one was diagnosed as follicular carcinoma.

Table 5: Benign nodule

Radiological diagnosis	FNAC	HPE	
		Benign	Malignant
9	**9**	4	1 follicular carcinoma

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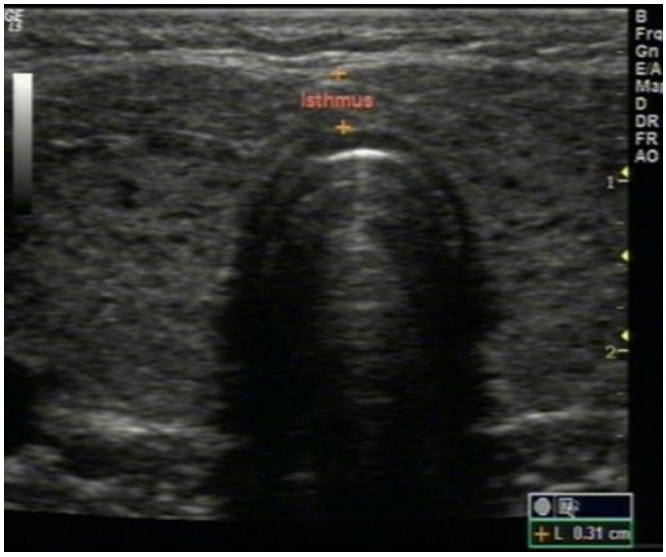
Figure 3: Shows a benign adenomatous nodule with smooth uniformly hyperechoic nodule with no calcifications or increased vascularity

Nine patients were diagnosed as thyroiditis and the sonographic appearance of thyroiditis was isoechoic / hypoechoic / heteroechoic. Hypoechogenicity was the predominant echo pattern in these patients. Of all the 9 patients, FNAC revealed Hashimoto thyroiditis [Figure 4] in 6, colloid goiter in 1 and lymphocytic thyroiditis in 2 cases. HPE was available only for 1 patient, which showed adenomatous goiter.

Figure 4: Transverse section through the midline demonstrated characteristic diffuse micronodular appearance with mildly thickened septae, a feature of thyroiditis.



Six cases were diagnosed as thyroid neoplasm accounting for 6.6% of the cases. Most of the patients with thyroid neoplasm had heteroechoic appearance [Figure 5]. Thick halo was found in all cases while only 1 case had coarse calcification and 5 had fine calcifications. Hypoechogenicity was found in 1 case but unfortunately many benign nodules are also hypoechoic. Fine calcifications were seen in 5 cases with

suggested malignancy. Pathologically these calcifications may be caused by psammoma bodies which are commonly seen in papillary cancers. Hence these features of hypoechogenicity, fine calcification and thick irregular halo suggested neoplasm. Psammoma calcifications may also be found in the nodes [Figure 6]. Of all the 6 cases, 1 was benign nodule. In other four, it showed papillary neoplasm. HPE was available for only 5 cases, in which 1 turned out to be benign and four were papillary carcinoma [Table 6].

Table 6: Thyroid neoplasm

Radiological diagnosis	FNAC	HPE	
		Benign	Malignant
6	6 Papillary - 5 Benign nodule – 1	1	4

One case referred as thyroglossal cyst was cystic nature of the lesion with HPE result of thyroglossal cyst.

Figure 5: Shows a nodule with cystic change. HPE confirmed the diagnosis as papillary carcinoma

Figure 6: shows a draining cervical lymph node with echo texture and microcalcifications similar to papillary carcinoma of thyroid gland.

Table 7: Results of accuracy of ultrasound in identifying benign and malignant lesions in various studies

Author	Years	Sensitivity (%)	Specificity (%)	Accuracy (%)
Jones et al.	1990	75	61	
S Arda-et al.	2001	60	59	59
Kamaljit kaur et al.	2002	71.4%	77%	
Nggada HA et al	2003	70.3	81	66
A. Kessler et al	2005	76.2	80	83
F. Basolo et al	2009	70	91	95
Present Study		**66.6%**	**96.7%**	**91%**

Table 7 depicts the diagnostic accuracy of ultrasound in identifying benign and malignant thyroid lesions

DISCUSSION

Significant female preponderance was noted in the group of patients with females constituting 86.8% of the study group and males constituting 13.2%. A similar female preponderance in thyroid disease was noted of in previous studies [4,5].

The commonest thyroid pathology encountered in the study was colloid goiter (53%). Most of the cases were heteroechoic in pattern followed by isoechoic appearance. Most of the colloid nodules had cystic degeneration. Coarse calcification was seen only in 11%. A thin halo was seen in 27 patients (55%). Micro calcification and rim calcification was not seen in any of the colloid goiter cases. Ultrasound identified all cases of colloid goiter accurately except for one case which turned out to be papillary carcinoma. Multinodular goiter comprised the second largest group (18.8%) of total cases and ultrasound identified all these cases correctly.

Benign nodules comprised 10% of the cases. Isoechogenicity was the most common echo pattern noted in these cases followed by hypoechogenicity. None of the cases had any kind of calcification. A thin well defined halo was present in 77% of cases while 23% had thick halo. All the patients had well defined margins. Of all these patients, only 5 patients had HPE which revealed benign adenomatous goiter in four, but one case was diagnosed as follicular carcinoma after the FNAC had suggested a follicular neoplasm. Similar imaging features were reported by Fobbe et al. [6] and Clark et al [7].

There were 9 cases of thyroiditis in the study. Hypoechogenicity was the most common echo pattern noted in the cases. Only 2 cases had heterogenous pattern while isoechogenicity was not seen in any of the cases. None of the patients had calcification or any cystic degeneration. Similar gray scale findings were reported in thyroiditis by various authors Birchal et al [8] and Blum et al [9]. HPE was available for only one case which showed adenomatous goitre.

A total of 6 cases of thyroid neoplasm were present in the study, of which only 5 cases had HPE. One case turned out to be benign follicular adenoma while 4 cases were of papillary carcinoma. Papillary carcinoma was the commonest thyroid malignancy. The commonest echo pattern noted was heteroechoic pattern. Hypoechogenicity was found in 3 cases but unfortunately many benign nodules are also hypoechoic. In fact most hypoechoic nodules are benign. Fine calcifications were seen in 5 cases which suggested malignancy. Pathologically these calcifications may be caused by psammoma bodies which are commonly seen in papillary cancers. Hence these features of hypoechogenicity, fine calcification and thick irregular halo suggested neoplasm. Various authors have described predominantly cystic lesions also [10].Hyper echoic pattern is rarely seen. Only 3 patients (50%) had thick ill-defined halo. Coarse calcification was seen only in 2 cases. Only one of the cases had any extra thyroid involvement in the form of cervical nodal metastasis which showed almost similar sonographic features in the lesion and node. Other extra thyroid involvement like muscle invasion, carotid entrapment and tracheal infiltration were not seen in any of the cases. There was one case of follicular carcinoma. It appeared well circumscribed and predominantly isoechoic with a very thin and complete halo and no other features like calcifications were noted thus revealing no obvious features of malignancy. FNAC suggested a follicular neoplasm and was confirmed as follicular carcinoma by HPE. No cases of medullary, anaplastic or metastasis to thyroid were present.

The present study had a sensitivity of 66.6%, specificity of 96.7% and diagnostic accuracy of 91%. The sensitivity and specificity of USG in various studies range from 60-81% and 59-95% respectively. Table 8 shows the same.

CONCLUSION

High resolution sonography has an undeniable role in evaluating thyroid diseases. It demonstrates thyroid abnormalities with remarkable clarity due to its superficial location in the neck. It has been used to distinguish normal from abnormal thyroid and to classify the abnormalities as diffuse or focal. Sonography has also been used to characterize the morphology of the lesion and suggest a pathologic diagnosis. It is also very useful for differentiating benign and malignant lesions of the thyroid as demonstrated in our study.

Sonographic differentiation of benign and malignant nodules includes the following:

1. Echogenicity: A nodule that has significant cystic change is more likely to be benign. Thyroid cancers are usually hypoechoic while benign nodules are usually hyperechoic.

2. Halo: A peripheral halo that completely surrounds a thyroid nodule more likely to represent benign than malignant lesions.

3. Margins: Benign modules tend to have sharp well defined margins, whereas malignant lesions have irregular or poorly defined margins.

4. Calcification: Fine calcifications are more suggestive of thyroid cancer while macro calcification suggests benign nodule.

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