EVALUATION OF THYROID NODULES WITH GREY SCALE AND POWER DOPPLER IN THE DETECTION OF MALIGNANCY AND THEIR ULTRASOUND GUIDED FNAC CORRELATION

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Abstract

A study was conducted to identify the most suitable grey scale features to differentiate between malignant and benign thyroid nodules and to study role of Doppler in assessment of thyroid malignancy. In this descriptive study 100 subjects referred from surgical OPD of Dr. SMCSI Medical College Hospital, Karakonam, Thiruvananthapuram for a period of 2 years were included. The study was done using Siemens Sonoline 50 ultrasound scanner with Colour and Duplex Doppler features. Linear 5-10MHz probe was used. Nodules in thyroid were studied in detail and morphological features were identified using different ultrasound parameters and doppler features. The nodule is further evaluated by fine needle aspiration cytology under ultrasound guidance and the Cytopathology report is compared to that of the ultrasound features. Among the 100 subjects studied, the incidence of malignancy observed was 12%. The commonest lesion was colloid nodule (n=69) followed by follicular adenoma (n=13). The commonest malignancy lesion was papillary carcinoma. All the morphological gray scale features like margin of the lesion, echogenicity, echotexture, peripheral halo, microcalcification were studied and had significant P value. Hence grey scale evaluation using them can be used for objective analysis of thyroid masses. Among the doppler features studied, Type III vascularity was seen on 54% cases, which included 45 benign and 9 malignancy cases. Type I/ Type II vascularity was seen in 3 malignant cases and 43 benign cases. Sensitivity and specificity of the type III vascularity in prediction of malignancy is 75% and 48.5% respectively. The findings of the present study indicated that grey scale features provide the most discriminating parameters than intranodular vascularity for differentiating benign from malignant thyroid nodules.

Introduction

Thyroid nodules are a common clinical problem with prevalence varying according to method of examination used. Ultrasonography is the most sensitive diagnostic tool for detecting presence of thyroid nodule [1]. Thyroid nodules are very common and may be observed in Ultrasonography (US) in 50% of the adult population [2]. Malignant tumours occur in upto 10-20% of palpable nodules that have been selected for surgical treatment [3], [4] and [5]. The issue of how best to manage the current epidemic of thyroid nodules is an increasingly cost-constrained environment is a critical one. A logical strategy for indentifying the thyroid nodules that require surgical intervention is a topic of much debate. High resolution ultrasound is the most sensitive imaging test available for examination of thyroid gland to detect thyroid lesions, accurately calculate their dimensions, identify internal structure, vascularisation and evaluate diffuse changes in thyroid parenchyma. Few prospective studies have addressed the systematic evaluation of thyroid nodules detected at sonography to correlate the ultrasound and doppler [CFD] findings with prevalence of cancer and its pathologic staging [6], [7]. The principal method of diagnosis is fine needle aspiration cytology (FNAC). FNAC is safe, cost effective and may be performed in an outpatient setting. FNAC has been shown to reduce the percentage of patients requiring thyroidectomy whilst doubling the yield of malignancy in operated patients [8], [9]. The final assessment of thyroid nodule is by fine needle aspiration cytology [10]. FNAC findings play a vital role in selecting patients for surgery and its accuracy is very important in patient management. The present study is aimed to identify the most suitable grey scale features to differentiate between malignant and benign thyroid nodules and to study role of Doppler in assessment of thyroid malignancy.

Materials and Methods

This study was conducted on 100 subjects referred from surgical OPD of Dr. SMCSI Medical College Hospital, Karakonam, Thiruvananthapuram for a period of 2 years. 100 subjects were included in the study. Inclusion criteria were subjects with 1. All nodules greater than 8mm size 2. Subject with single and multiple thyroid nodules. Exclusion criteria included 1.Normal thyroid gland. 2. Diffusely enlarged thyroid without nodule. 3. Cases were no consent was obtained. Ethical clearance was obtained from institutional review board for this study.

The study was done using Siemens Sonoline 50 ultrasound scanner with colour and duplex doppler. Linear 5-10MHz probe was used. The colour doppler parameters were optimized for detection of slow flow. Both longitudinal and transverse measurements of both lobes of thyroid gland and isthmus were made. Nodules in thyroid were studied in detail and morphological features were identified.

The following ultrasound parameters were evaluated.

Table. 1 - Grey scale features evaluated in the study

Margin/ Contour	Well defined	-	Ill defined
Peripheral	Yes	-	No
Echogenicity	Hyperechoic	Isoechoic	Hypoechoic
Internal composition	Cystic	Solid and cystic	Solid
Microcalcification	No	-	Yes

Doppler features

Location of flow in the nodule at colour imaging.

Type I - No vascularity

Type II - Peripheral vascularity

Type III - Peripheral and intra nodal vascularity

Cytological sampling

The nodule is further evaluated by FNAC under ultrasound guidance and the cytopathology report is compared to that of the morphological features. In case of multiple nodules, the nodule which shows the most relevant morphological characteristics of malignant nodules is chosen for sampling.

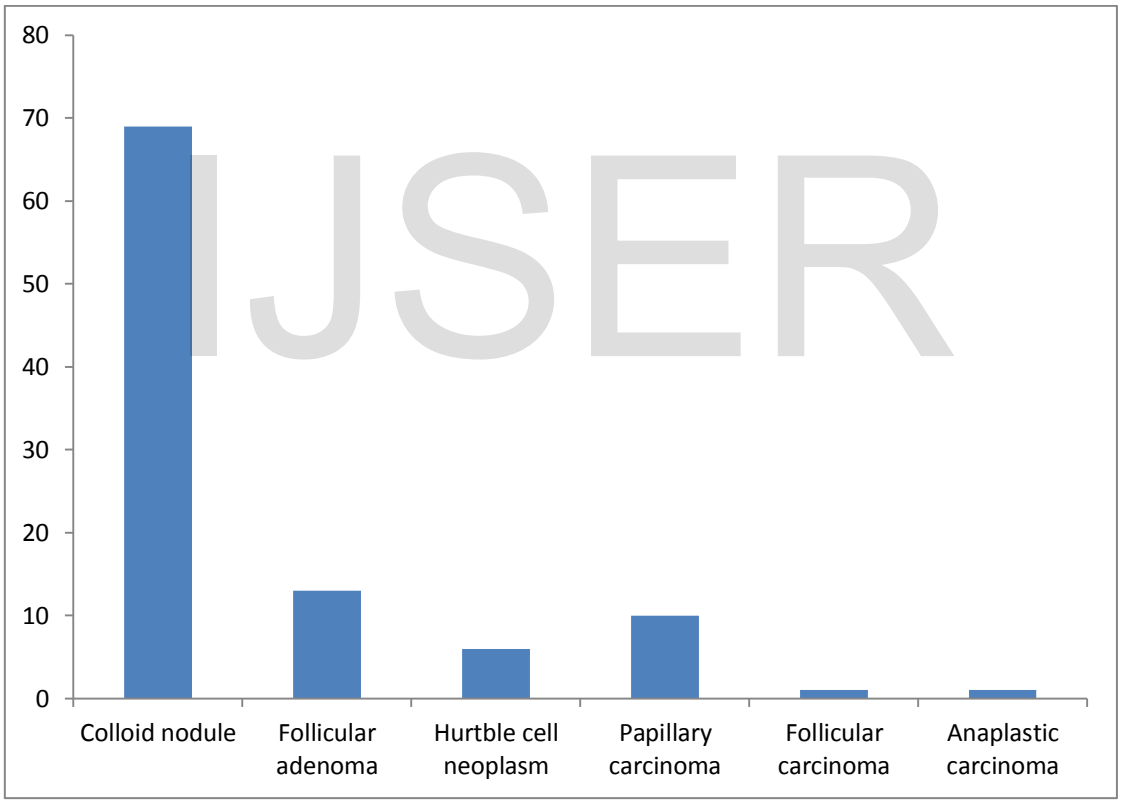
Observation and Results

In the 100 subjects studied, the commonest lesion was colloid nodule (n=69) followed by follicular adenoma [n=13]. The commonest malignant lesion was papillary carcinoma (Figure 1), (Table 2).

Table. 2 – Pathological distribution of lesions

Sl.No.	Pathologic diagnosis	Number of lesions
1	Colloid nodule	69
2	Follicular adenoma	13
3	Hurtble cell neoplasm	6
4	Papillary carcinoma	10
5	Follicular carcinoma	1
6	Anaplastic carcinoma	1
	Total	100

Fig. 1 – Pathological distribution of lesions



Univariable analysis of grey scale features.

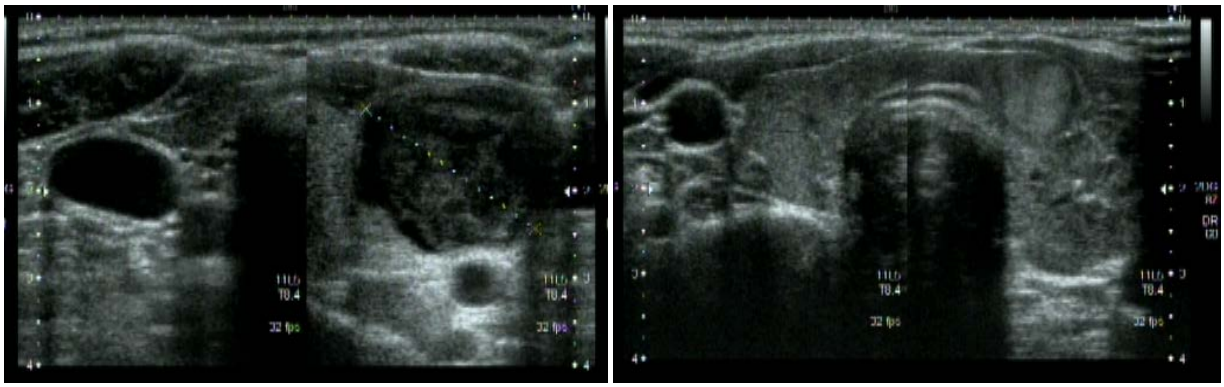
1. Margin of the lesion

Margin of the 12 histologically proven malignant cases 7cases showed ill defined margins. Of the total 88 benign cases majority, 81 cases showed smooth margin. Prediction of malignancy by ill defined margins has a sensitivity of 58.3% and specificity of 92%.

2. Echogenicity

Out of 12 histologically proven cases 11 cases showed hypoechoic echogenicity and majority of benign lesion showed hyperechoic/ isoechoic echogenicity. For prediction of malignancy by hypoechoic echogenicity sensitivity and specificity are 91% and 67% respectively.

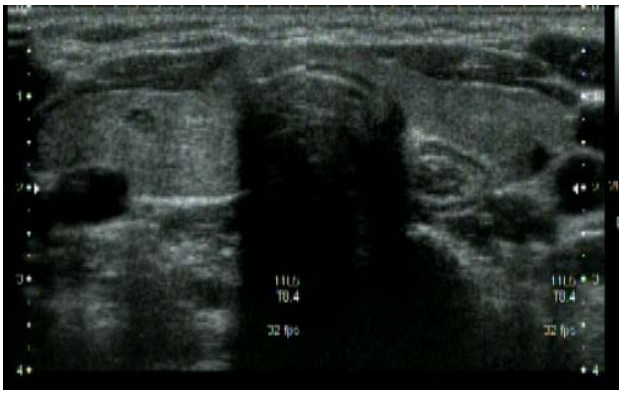
Fig. 2 Markedly hypoechoic thyroid nodule. Fig. 3 Echogenic thyroid nodule



3. Echotexture

Out of the 12 malignant cases 7 cases were solid and 5 cystic / heterogeneous. Out of the 88 benign cases 24 cases showed solid echotexture. Sensitivity for prediction of malignancy by solid echotexture is 58.3% and specificity 72.7%.

Fig. 4 Thyroid nodule with cystic degeneration Fig. 5 Thyroid nodule with peripheral halo



4. Peripheral halo

No peripherally halo was seen in 11 histopathologically proven cases. Out of the 88 benign cases only 12 cases showed no peripheral halo. Prediction of malignancy by no peripheral halo showed sensitivity of 91.7% and specificity of 86.4%.

5. Microcalcification

7 out of the 12 cases of malignancy, 7 cases showed no microcalcification and out of the 88 benign cases only single case showed micro calcification. Prediction of malignancy by micro calcification showed a sensitivity of 58.3% and specificity of 98.9%.

All the morphological gray scale features studied had significant P value so grey scale evaluation using them can be used for objective analysis of thyroid masses.

Table 3 – Univariable analysis of grey scale features of thyroid nodules

Grey scale feature		Histopathology				P value
		Malignancy		Benign		
		Count	Percent	Count	Percent	
Margin	Ill defined	7	50	7	50	P<0.001
	Smooth	5	5.8	81	94.2	
Echogenicity	Hypoechoic	11	27.5	29	72.5	P<0.001
	Hyperechoic/Isoechoic	1	1.7	59	98.3	
Echotexture	Solid	7	22.6	24	77.4	P<0.05
	Cystic / Heterogeneous	5	7.2	64	92.8	
Halo	Peripheral halo	11	47.8	12	52.2	P<0.001
	Peripheral halo present	1	1.3	76	98.7	
Calcification	Microcalcification	7	87.5	1	12.5	P<0.001
	No calcification/ Macrocalcification	5	5.4	87	94.6	

Power Doppler Sonography

Type III vascularity was seen on 54% cases which included 45 benign and 9 malignancy cases. Type I / Type II vascularity seen in 3 malignant cases and 43 benign cases. Sensitivity and specificity of the type III vascularity in prediction of malignancy is 75% and 48.9% respectively.

Fig. 6 Power Doppler – Thyroid nodule

Table 4 - Percentage distribution of the sample according to vascularity

Vascularity	Histopathology				P value
	Malignancy		Benign		
	Count	Percent	Count	Percent	
Type III vascularity	9	16.7	45	83.3	P<0.05
Type I/ Type II vascularity	3	6.5	43	93.5	

Fig. 7 – Percentage distribution of the sample according to vascularity

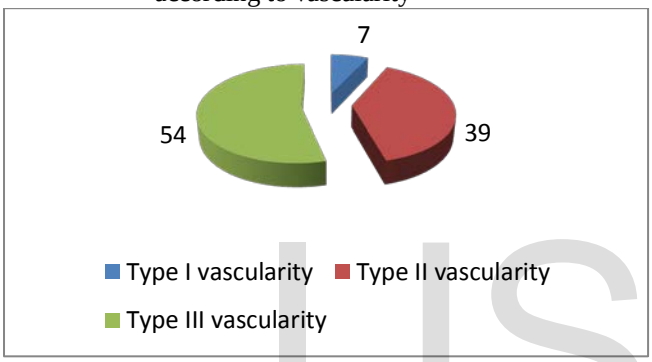
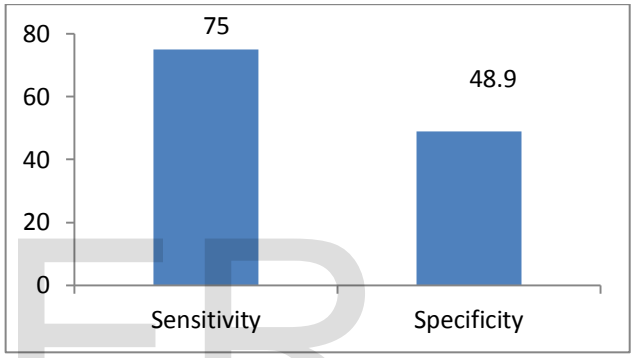


Fig. 8- Prediction of malignancy by power doppler



Discussion

The most significant test characteristics from the study were specificity (100%). Predictive value of positive test (100%). This study revealed that presence of micro calcification (98.9%) and irregular margin (92%) are presence of a higher specificity for malignancy. Echogenicity and peripheral ratio had high sensitivity (91.7%).

A thyroid nodule is considered ill defined when more than 50% of its border is not clearly demarcated. Furthermore nodules can be classified according to their contours as smooth and rounded or irregular. An ill-defined and irregular margin in a thyroid tumour suggests malignant infiltration of adjacent thyroid parenchymal with no pseudocapsule formation. The reported sensitivity of ill-defined and irregular margins ranges widely 53%-89% [11], [12] and [13]. The specificity of ill-defined margin is variable with 15%-59% of benign nodules having poorly defined margins [14], [15]. The present study showed higher specificity of 92% for the gray scale finding of irregular margin.

Microcalcification is found in 25-59% of all primary thyroid carcinoma [16]. Large irregularity shaped dystrophic calcification are commonly present in multinodular goiters smear. When found in solitary nodule they may be associated with malignancy rate of nearly 75% [17]. In the present study presence of microcalcification showed high specificity of 98.9% for malignancy.

A halo or hypoechoic rim around a thyroid nodule is produced by pseudocapsule of fibrous connective tissue, a compressed thyroid parenchyma and chronic inflammatory infiltrates [18]. Completely uniform halo around nodule is highly suggestive of benign with a specificity of 95% according to Lue et al [13]. However a halo is absent in more than half of all benign nodules [18, 19]. 10-24% of papillary ca have either complete or incomplete halo [13], [20]. Peripheral halo had high sensitivity of 91.7% for detection of benign lesions. In the present study malignant nodules both carcinoma and lymphoma typically show solid and hypoechoic when compared to normal thyroid parenchyma. The combination of these two features has a sensitivity of 87% for detection of thyroid malignancy as per study of Papins et al [14]. Prediction of malignancy of hypoechoic echogenicity had a sensitivity of 91.7% and specificity of 67% in the present study.

When thyroid nodule is markedly hypoechoic, a darker appearance than that of infra hyoid / strap muscles of neck specificity for detection of malignancy increase. Marked hypoechogenicity is highly suggestive of malignancy.

The univariable analysis of morphological characteristics revealed that individual morphological characteristics studied were significant in this study. Power doppler parameters was studied in both benign and malignant nodules. But it lacked sensitivity and specificity and failed to show significant statistical association (high p value).

Conclusions

1. Gray scale features provide the most discriminating parameters for differentiating benign from malignant thyroid nodules.
2. Features like no peripheral halo, irregular margins and marked hypoechoic appearance are associated with significantly increased probability of malignancy.
3. Intranodular vascularity does not show significant association in differentiating benign and malignant thyroid nodules.
4. The overall incidence of malignancy in the studied group was 12%.

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