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The Role of various Ultrasound parameters in the evaluation of Thyroid lesions and its correlation with Thyroid Cytopathology

Rupinder Kalra[1], Vandana Agrawal[*2], K.B. Mishra[3] and Alok Yadav[4]

[1]*P.G. Student, Department of Pathology, L.N. Medical College, Bhopal, India*
[2,3]*Professor, Department of Pathology, L.N. Medical College, Bhopal, India*
[4]*P.G. Student, Department of Radiology, ACPM Medical College, Dhule, Maharashtra, India*

QR Code

***Correspondence Info:**
Dr. Vandana Agrawal
Professor,
Department of Pathology,
L. N. Medical College, Kolar Road,
Bhopal - 462042, India

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Abstract

Objective: The objective of this study was to evaluate the diagnostic accuracy of various ultrasound parameters in the diagnosis of malignant thyroid nodules and to correlate ultrasonographic findings with cytological diagnosis as reference.
Material & Methods: In this prospective study a total of 165 patients attending the surgery/ENT OPD with complaints of thyroid swelling were included. On Ultrasonography the nodules were assessed on the basis of composition, echogenecity, margins, calcification, internal vascularity and presence of any associated lymphadenopathy. Sensitivity, Specificity and diagnostic accuracy of each individual US parameter was calculated. The results were then compared with cytological diagnosis.
Results: The incidence of malignancy in our study was 6.66% (11/165). Of all the ultrasound characteristics, a predominantly solid composition, presence of fine calcifications and irregular borders had high sensitivity but low specificity for the diagnosis of malignancy. On the other hand, presence of internal vascularity within the nodule had the highest specificity and overall diagnostic accuracy. The sensitivity, specificity and overall diagnostic accuracy of Ultrasound for characterising a malignant nodule were found to be 78.5%, 99.3% and 97.57% respectively.
Conclusion: Ultrasonography along with FNAC is useful in the initial evaluation of thyroid nodules. While histopathology remains the gold standard for establishing the final diagnosis, attention to specific ultrasound patterns appear to be useful indicators in suspicious nodules which in turn may avoid unnecessary surgical intervention in benign nodules.
Keywords: Thyroid nodules, Ultrasound, FNAC.

1. Introduction

Thyroid nodules are common; their prevalence in the general population varies depending upon the mode of discovery: 2-6 % (palpation), 19-35 % (ultrasound) and 8-65 % (autopsy data) [1-3].

Thyroid Ultrasound (US) is the major and most sensitive imaging modality available for the examination of the thyroid gland and associated abnormalities. It is widely available, safe, non invasive, has excellent resolution, detects non palpable and clinically silent nodules, and guides for fine needle aspiration of suspicious nodules. The imaging evaluation of a thyroid nodule comprises numerous ultrasound features: size, echogenecity, composition, presence or absence of calcifications, borders and presence of internal vascularity, which have been used as potential predictors of malignancy. However the sensitivity, specificity and predictive values of these ultrasound characteristics in differentiation between benign and malignant nodules are highly variable in the literature [4-6].

Fine Needle Aspiration Cytology (FNAC) of the thyroid gland is a well established first line tool for the evaluation of diffuse thyroid lesions as well as solitary thyroid nodules. FNAC is recommended for palpable thyroid nodules, but the indication in non palpable nodules is controversial. Combined application of US and FNAC may therefore aid in detecting majority of thyroid cancers undetected by routine clinical examination.[7]

The aim of this study was to evaluate the diagnostic accuracy of various ultrasound parameters in the diagnosis of malignant thyroid nodules, and to compare FNAC and ultrasonographic findings of thyroid lesions in order to assess the accuracy of FNAC in the diagnosis of thyroid pathology.

2. Material and methods

This prospective study was conducted at L.N. Medical College & Research Center and associated J.K Hospital Bhopal on 165 patients attending the surgery/ENT OPD with complaints of thyroid swelling. Relevant clinical data regarding age, sex, site, size and duration of the thyroid swelling, associated complaints, thyroid function test results and sonological findings was recorded prior to FNAC. This data was recorded in a carefully structured proforma.

A written informed consent was taken from all the subjects prior to the study. This study was approved by institutional ethical committee.

2.1 Inclusion criteria

- All patients having thyroid lesions, referred for FNAC from ENT and Surgery OPD and IPD
- Impalpable thyroid lesions< 1 cm in diameter detected during USG examination of head and neck.
- Very small incidental thyroid lesions less than 1 cm diameter, with suspicious USG appearance, a family history or prior radiation to the head and neck region.

2.2 Exclusion criteria

- Neck swellings other than thyroid were excluded.
- All the patients with bleeding diathesis.

The Ultrasound examination was carried out using WIPRO GE scanner equipped with a 7MHz to 10 MHz linear transducer. The nodules were assessed on the basis of internal composition, echogenecity, margins, calcification, internal vascularity and presence of any associated lymphadenopathy.

All the nodules underwent either palpation or ultrasound guided FNAC. Aspiration of the thyroid was performed with 22 or 23 gauge needle. If cystic fluid was obtained, the needle aspiration was continued so long as the fluid keeps flowing. Once a cystic lesion, was completely evacuated, the residual lesion was re-aspirated for the cellular tissue left behind. For each case PAP and Giemsa staining of smeared slides was done.

2.3 Statistical Analysis

The data collected was entered into MS excel spread sheets and analysis was carried out using SPSS version 20. Sensitivity, specificity and overall accuracy were calculated for individual US parameters. The overall diagnostic accuracy of thyroid US in the differentiation of benign and malignant nodules was also assessed.

3. Results

A total of 165 patients (23 males and 142 females), with a mean age of 41.3 ± 12.39 years (12-75 years range) were included in the study.

All the 165 patients were subjected to both USG and FNAC. Taking into consideration the various ultrasonographical features such as composition of the nodule, echogenecity, margins, calcification, internal vascularity and presence of any associated lymphadenopathy; cases were classified into benign, suspicious and malignant.(Table 1)

Table 1: Distribution of thyroid lesions according to ultrasound diagnosis

S. No.	USG Diagnosis	No. of cases	%
1.	Benign	152	92.1
2.	Suspicious / Indeterminate	2	1.21
3.	Malignant	11	6.66
	Total	165	100

The sonographic criteria used in the study were based on previously published criteria.[7-9]

The USG findings in the 165 thyroid lesions are summarised in Table 2.

Table 2: Sonographic patterns of various Benign and Malignant thyroid lesions

Echogenecity			
	Benign	Malignant	Total
Hypoechoic	70	7	77
Hyperechoic	18	2	20
Isoechoic	15	2	17
Mixed	49	2	51
Composition			
	Benign	Malignant	Total
Solid	54	9	63
Cystic	42	0	42
Mixed	57	3	60
Calcification			
	Benign	Malignant	Total
Absent	112	2	114
Coarse	36	0	36
Fine	5	10	15
Borders			
	Benign	Malignant	Total
Regular	125	3	128
Irregular	28	9	37
Internal vascularity			
	Benign	Malignant	Total
Avascular	122	0	122
Increased	17	4	21
Peripheral	13	1	14
Internal	1	7	8
Lymphadenopathy			
	Benign	Malignant	Total
Present	12	6	18
Absent	141	6	147

All the malignant nodules diagnosed in our series were either solid or of a mixed consistency on USG. None of the cystic nodules were malignant. The majority of the malignant nodules (7/12) showed hypoechoic internal echotexture. Most of the malignant nodules (9/12) had poorly defined margins i.e. the margins were either indistinct or irregular in outline. Calcifications were seen in 10/12 malignancies. These calcifications were fine calcifications. Majority of the malignant lesions (7/12) showed internal vascularity within the nodule, while benign nodules were predominantly avascular. Associated lymphadenopathy was seen in 50% cases of malignancy.

The ultrasound diagnosis was compared with the cytopathological diagnosis and the sensitivity, specificity, and diagnostic accuracy of ultrasound and as well as the individual sonographic features in predicting malignancy in a thyroid nodule was calculated (Table 3 and Table 4). Of all the ultrasound characteristics, a predominantly solid composition, presence of fine calcifications and irregular borders had high sensitivity but low specificity. On the other hand, presence of internal vascularity within the nodule had the highest specificity and overall diagnostic accuracy.

Table 3: Statistical analysis of thyroid US with FNAC in 165 patients

		Cytology		
		Malignant	**Benign**	**Total**
Ultrasound	Malignant	11	01	12
	Benign	3	150	153
	Total	14	151	165

Sensitivity: 78.5 %
Specificity: 99.3 %
Accuracy: 97.57 %

Table 3: Diagnostic accuracy of various US parameters for malignant nodules

USG Feature	**Sensitivity (%)**	**Specificity (%)**	**Accuracy (%)**
Solid / Predominantly Solid	100	72.5	65.5
Hypoechogenecity	53.9	53.9	53.9
Fine Calcification	75.0	73.2	73.9
Irregular margins	75.0	81.7	81.2
Internal Vascularity	58.3	99.3	96.3

4. Discussion

High resolution thyroid ultrasound is the most useful diagnostic modality for differentiation between benign and malignant nodules. Several US features have been considered as potential predictors for the presence of thyroid malignancies. However the sensitivity, specificity and diagnostic accuracy for these criteria are extremely variable in various studies. No single sonographic feature is accurate. Therefore several guidelines with various combinations of ultrasound parameters have been suggested.[4,11,12]

All the malignant nodules in our study were solid or predominantly solid, thus having a sensitivity of 100%. However, the specificity was low indicating that some solid nodules could also be benign. These results compare favourably with those of Rajendra Kumar *et al*[13] and Sharma *et al*[14] who also reported a similar sensitivity of 100%.

Malignant nodules typically appear hypoechoic when compared to the normal thyroid parenchyma. However our study reported a low sensitivity and specificity as compared to other studies thereby implying that hypoechogenicity alone is a poor predictor of malignancy. .

Presence of microcalcifications in our study had a sensitivity, specificity and diagnostic accuracy which was comparable to that of Sharma *et al*.[14] Several reports have suggested a high specificity of 85% to 95% for the presence of microcalcifications in papillary cancers which was also noted in our study. Malignant nodules tend to have irregular margins due to the infiltrative nature of their growth. Our results compare favourably with the studies of Ru Quang Li *et al*[15] and Sharma *et al*.[14]

In our study presence of internal vascularity within the lesion had the highest specificity for diagnosing a malignant lesion but a low sensitivity as compared to the other studies .This was due to the fact that in the present study majority of benign lesions showed peripheral vascularity.

Hence according to our study, no individual US parameter is fully a predictor of malignant lesion and simultaneous consideration of several ultrasound characteristics improves the diagnostic yield.

Table 6: Comparative study of Sensitivity & Specificity of various Ultrasound Features

Authors	**Rajendra Kumar *et al* [13]**		**Ru Quiang Li *et al* [15]**		**Sharma *et al* [14]**		**Present Study**	
USG features	**Sensitivity %**	**Specificity %**	**Sensitivity %**	**Specificity %**	**Sensitivity %**	**Specificity %**	**Sensitivity %**	**Specificity %**
Solid Composition	100	38.1	89.2	47.4	100	43.5	100	72.5
Hypoechogenecity	67.8	92.8	89.7	55.6	85.7	67.7	53.9	53.9
Fine Calcification	50.0	94.0	44.8	90.6	78.5	77.5	75.0	73.20
Irregular margins	64.3	95.2	72.1	79.8	78.5	82.2	75.0	81.7
Internal Vascularity	71.4	78.9	45.8	68.8	85.7	64.5	58.3	99.3

5. Conclusion

Ultrasonography along with FNAC is useful in the initial evaluation of thyroid nodules. Ultrasonography is valuable for identifying many malignant or potentially malignant thyroid nodules. While histopathology remains the gold standard for establishing the final diagnosis, attention to specific ultrasound patterns appear to be useful indicators in suspicious nodules which in turn may avoid unnecessary surgical intervention in benign nodules. The most useful indicators in our study were a solid composition, presence of microcalcifications and irregular margins.

Conflict of interest: None.

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