



## Diagnostic Accuracy of Gray Scale Ultrasonographic Features for the Differentiation of Benign and Malignant Thyroid Nodules Using Fine Needle Aspiration Cytology as the Reference Standard

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Type of Publication: Original Research Paper

Conflicts of Interest: Nil

### ABSTRACT

**Background:** High resolution Gray scale ultrasonography has emerged as an initial imaging modality of choice for the evaluation of patients with thyroid enlargement. Thyroid malignancy cannot be diagnosed on ultrasonography but various ultrasonographic features in combination can be used to predict malignancy in thyroid lesions.

**Objective:** To evaluate the diagnostic accuracy of ultrasonographic features for the differentiation of benign and malignant thyroid nodules by using FNAC as the reference standard.

**Materials And Methods:** The present study was a prospective study of 200 patients who attended Department of ENT Government Medical College Srinagar with thyroid nodules from August 2014 to February 2017. A High-resolution gray scale ultrasonography of the Thyroid gland was performed along with a Color-Flow Doppler study. Ultrasonographically guided FNAC was then performed by the standard technique. Pre-FNAC sonograms were interpreted with respect to number of nodules, nodule size (largest diameter of largest nodule, if more than one), echogenicity, echo structure, shape, border characteristics, presence or absence of calcifications and vascularity on Color Flow Doppler examination. All statistical calculations were performed using a 2 x 2 contingency table and  $\chi^2$  analysis. Data associations were considered statistically significant at  $p < 0.05$ .

**Results:** Mean age was 38.91 years  $\pm 10.85$  years. There were 47 males and 153 females with a male: female ratio of 1:3.26. Overall, majority (94%) of nodules were benign predominated by colloid nodules. Malignant nodules accounted for 6% of cases, out of which papillary carcinoma was most common. Microcalcifications, irregular/ill-defined margins, Hypoechogenicity, Taller than wide shape, and Internal vascularity were the sonographic features found to be significantly associated with malignancy.

**Keywords** Thyroid Nodule, Ultrasonography, Fine Needle Aspiration Cytology (FNAC), Malignant, Benign.

### INTRODUCTION

Being extremely common, the goal in management of nodular disease of the thyroid is to avoid extensive and costly evaluation in the most patients with benign disease without missing the minority of patients who have thyroid cancer. Current practice among most clinicians is to further evaluate any thyroid nodule that is palpable on physical examination by sonographically guided FNAC to rule out malignancy. Several studies have sought to identify sonographic features that are both sensitive and specific for malignant versus benign disease, but currently much debate exists as to whether such features have been successfully identified<sup>1,2,3</sup>. Sonographic features that have been identified in previous studies as being suggestive of malignancy include marked hypoechogenicity, irregular or microlobulated borders, a shape that is more tall than wide, intranodular vascularity, and the presence of microcalcifications.<sup>1,2,4</sup>. The purpose of this study was to further evaluate the

correlation between various sonographic features of thyroid nodules and their risk for malignancy in an attempt to suggest an optimal diagnostic approach to further workup of these lesions.

### Aims & Objectives

To evaluate the diagnostic accuracy of ultrasonographic features for the differentiation of benign and malignant thyroid nodules by using FNAC as the reference standard.

### Materials & Methods

The study was conducted in the Department of Pathology in collaboration with Department of ENT and Department of Radiodiagnosis and Imaging, Government Medical College Srinagar from August 2014 to February 2017. The present study was a prospective study of 200 consecutive patients who attended Department of ENT with thyroid nodules and gave consent for being included in the study. Patients already having a cytological or histopathological diagnosis of thyroid lesion and where FNAC showed inadequate aspirated material were excluded from the study. After enrolling the patients on a pre-structured proforma, a High-resolution grey scale sonography of the thyroid gland was performed along with a color-flow Doppler study. Sonographically guided FNAC was then performed by the standard technique. Pre-FNAC sonograms were interpreted with respect to number of nodules, nodule size (largest diameter of largest nodule, if more than one), echogenicity, echo structure, shape, border characteristics, presence or absence of calcifications, and vascularity on color flow Doppler examination. Nodules for which all characteristics could not be assessed were excluded from the analysis. The specific pathologic diagnosis for each case was confirmed by pathologic reports from Ultrasonographically guided Fine Needle Aspiration cytologic examinations. Individual sonographic features as well as various combinations of features were then analyzed for their correlation with malignant pathologic findings. All statistical calculations were performed using a  $2 \times 2$  contingency table and  $\chi^2$  analysis. Data associations were considered statistically significant at  $p < 0.05$ . The sensitivity, specificity, positive predictive value, and negative predictive value were defined for each individual sonographic feature in the detection of non benign masses.

### Results

Age ranged from 11 to 67 years. Mean age was  $38.91 \text{ years} \pm 10.85 \text{ years}$ . There were 47 males and 153 females with a male: female ratio of 1:3.26. ( $p=0.000$ ). Thus there were significantly more women than men presenting with thyroid nodules. 171 (85.5%) cases had only one thyroid nodule. 29 (14.5%) had two or more nodules. The size of nodules (largest diameter) ranged from 5 mm to 50 mm. Mean size was  $21.37 \text{ mm} \pm 10.28 \text{ mm}$ . Overall, majority (94%) of nodules were benign predominated by colloid nodules. Malignant nodules accounted for 6% of cases, out of which papillary carcinoma was most common.

### Discussion

In the present study most of the patients (32.5%) were in 30-40 years age group. 77% patients were females and 23% were males with a male: female ratio of 1:3.26. In a study by Ankush Dhanadia et al.<sup>5</sup>, 72% patients were female and 28% were male. The male to female ratio was 1:2.5. So females are more commonly affected than males. Out of 200 cases 94% were benign and 12 (6%) were malignant. Papillary carcinoma was seen in 11 out of 12 cases (5.5%), follicular Neoplasm in 7 cases (3.5%) and medullary carcinoma in 1 (0.5%) of cases. In a study by Joseph F. Simeone et al.<sup>6</sup>, 87.2% cases were benign and 12.7% cases were malignant. Most common benign pathology in the present study was colloid goiter seen in 162 (81%) cases. Follicular neoplasm was found in 7 cases (3.5%) and thyroiditis in 12 (6%) of patients. In the present study, among benign nodules 31.9% lesions were hypoechoic, 38.8% were hyperechoic, 18.1% were isoechoic and 11.2% showed mixed echogenicity. Perilesional Halo was seen in 28.7% cases, Coarse calcification in 19.7% cases and Microcalcification in 3.2%. Margin were well-defined in 84.6% and ill-defined in 15.4%. 52.7% were solid, 25% were cystic and 22.3% had solid-cystic components. Out of 12 malignant cases, 83.3% were in the age group of 30-60 years. Percentage of malignancy in male was 10.6% and in female it was 4.6%. 75% malignant lesions were hypoechoic, 16.7% were hyperechoic and 8.3% were of heterogeneous echogenicity. 66.7%

malignant cases had calcification within nodules. Margin of lesions were well-defined in 25% and ill-defined in 75% of cases. 50% of the malignant lesions showed perilesional Halo.

## Conclusion

High resolution grey scale ultrasound has emerged as an initial imaging modality of choice for the evaluation of patients with thyroid enlargement. Ultrasound can detect solitary nodule, multiple nodules and diffuse thyroid enlargement. It can also differentiate solid and cystic lesions. Various sonographic features like number, echogenicity, solid/cystic component, margin, peripheral halo, calcification and comet tail artifact help to characterize the thyroid lesion which is not possible on any other imaging modality. Neck masses can be differentiated whether they are arising from thyroid or extrathyroidal tissue. Thyroid lesions with capsular invasion, displacement of adjacent structure and cervical lymph nodes enlargement can also be detected. Thyroid malignancy cannot be diagnosed on ultrasonography but various sonographic features in combination can be used to predict malignancy in thyroid lesions. Using these multiple features grey scale ultrasound has accuracy of 74% with sensitivity of 83.3% and specificity of 72.7% for detecting thyroid malignancy, considering USG guided FNAC as a standard. FNAC is always suggested for the final confirmation of diagnosis in sonographically detected suspicious thyroid nodule. Real time sonography is a valuable tool to guide the needle for FNAC, especially for the small size thyroid nodule (< 1.5 cm) as well as for the aspiration of cysts. As per our results, the best compromise between risk of missing carcinomas of potential clinical aggressiveness and the need to avoid unnecessary procedures is to use FNAC on nodules with at least one of following sonographic features:

- ☐ Microcalcifications
- ☐ Irregular/ill-defined margins
- ☐ Hypoechogenicity
- ☐ Taller than wide shape
- ☐ Internal vascularity.

## References

1. Papini E, Guglielmi R, Bianchini A, et al. Risk of malignancy in nonpalpable thyroid nodules: predictive value of ultrasound and color-Doppler features. *J Clin Endocrinol Metab* 2002;87:1941–1946.
2. Kim E, Park CS, Chung WY, et al. New sonographic criteria for recommending fine-needle aspiration biopsy of non-palpable solid nodules of the thyroid. *AJR Am J Roentgenol* 2002; 178:687–691.
3. Kang HW, No JH, Chung JH, et al. Prevalence, clinical and ultrasonographic characteristics of thyroid incidentalomas. *Thyroid* 2004; 14:29–33.
4. Frates MC, Benson CB, Doubilet PM, Cibas ES, Marqusee E. Can color Doppler sonography aid in the prediction of malignancy of thyroid nodules *J Ultrasound Med* 2003; 22:127–131.
5. Ankush Dhanadia, Harshad Shah, Asutosh Dave. Ultrasonographic and FNAC correlation of thyroid lesions. *Gujarat medical journal / march-2014 Vol. 69 No.1*
6. JF Simeone, GH Daniels, DA Hall, K McCarthy, DB Kopans, RT Butch, PR Mueller, DD Stark, JT Ferruci, CA Wang.
7. Sonography in the follow-up of 100 patients with thyroid carcinoma. *AJR* 148(1):45-49. Jan 1987.

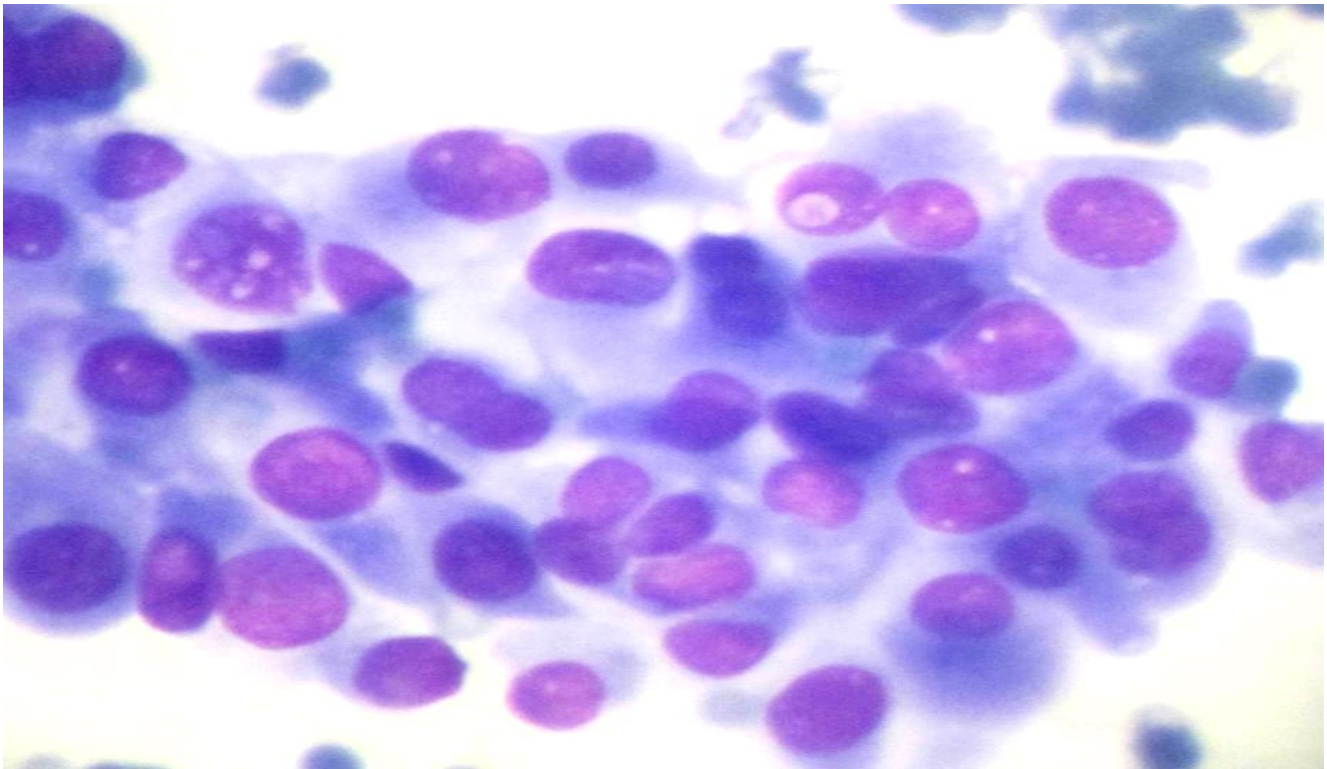
Diagnosis on FNAC	Number of cases	Percentage(%)	TBSRTC Category
Colloid nodule	162	81	Category II
Hyperplastic nodule	7	3.5	Category II
Thyroiditis	12	6	Category II
Follicular Neoplasm	7	3.5	Category IV
Papillary carcinoma	11	5.5	Category VI
Medullary carcinoma	1	0.5	Category VI

Table 1. Diagnosis on FNAC and TBSRTC Category.

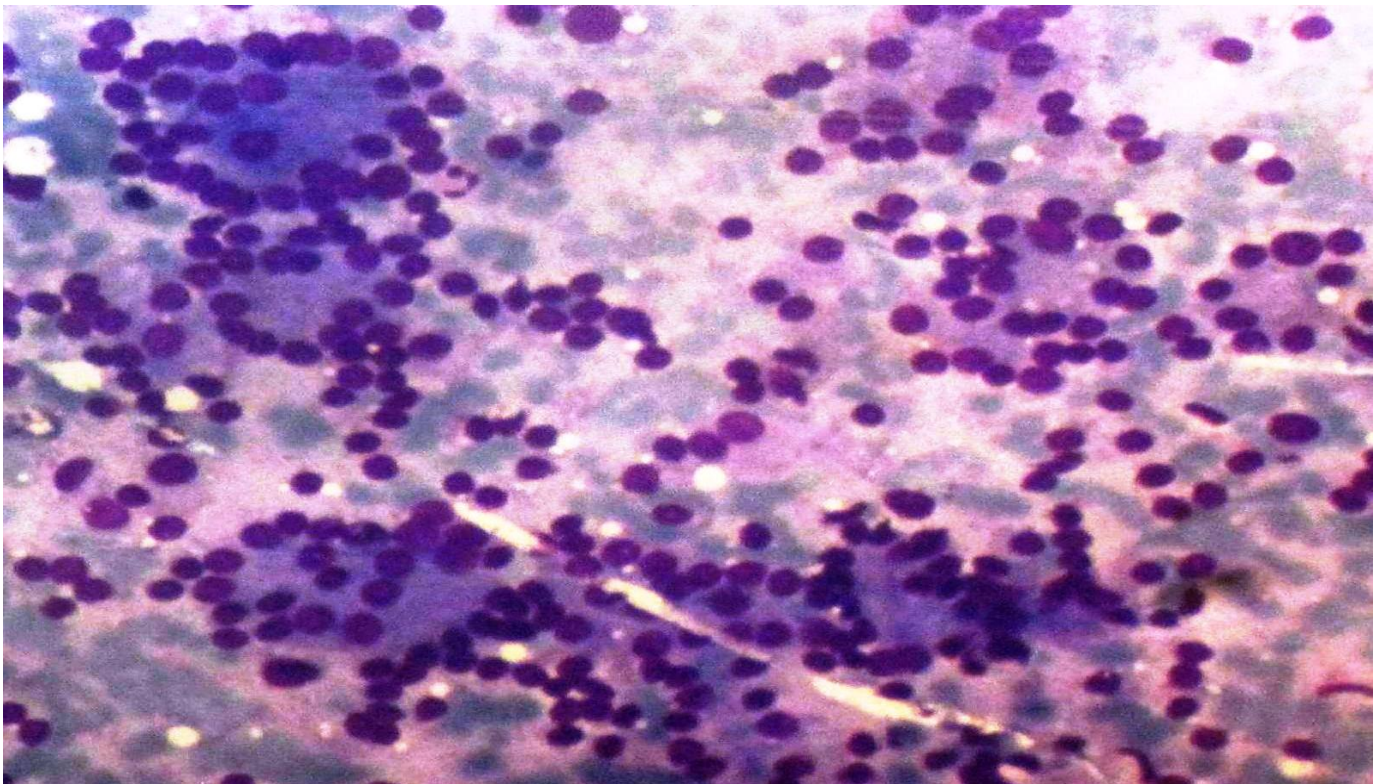
Ultrasonographic Feature	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Significance P value
Nodule size >10mm	100	20.2	7.41	100	0.084
Tall shape	25	99.47	75	95.4	0.000
Irregular/ill-defined borders	75	84.6	23.7	98.1	0.000
Presence of halo	50	71.3	10	95.7	0.119
Solid consistency	41.7	47.3	4.8	92.7	0.46
Hypoechoicity	75	68.1	13	97.7	0.002
Microcalcification	66.7	96.8	57.1	97.8	0.000
Internal vascularity	91.7	81.9	24.4	99.4	0.000

Table 2: Diagnostic accuracy of various ultrasound features predicting malignancy



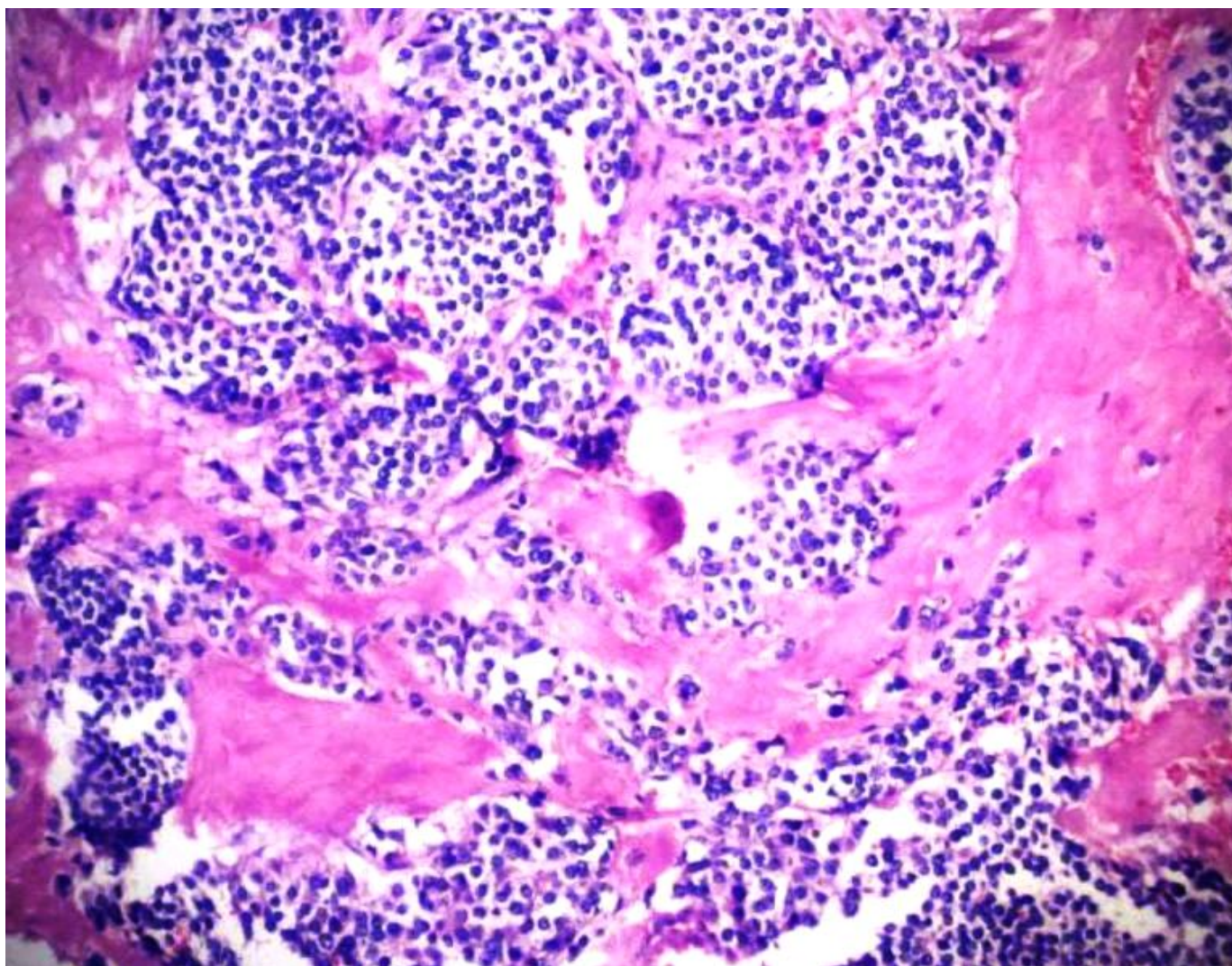


**Microphotograph 1: USG Guided FNAC Thyroid Nodule Reported as Papillary Carcinoma (TBSRTC Category VI).**



**Microphotograph 2: USG Guided FNAC of Thyroid Nodule reported as Follicular Neoplasm (TBSRTC Category IV)**





**Microphotograph 3: HPE of case reported as Medullary Carcinoma (TBSRTC Category VI) on FNAC and confirmed on HPE**