

# Role of Ultrasonography in the Evaluation of Thyroid Nodule with Fine Needle Aspiration Cytology ( FNAC) Correlation

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## ABSTRACT

**Introduction:** Thyroid nodules are commonly encountered pathologies worldwide. High-resolution ultrasonography is the first-line investigation for the evaluation of thyroid nodules as it is a cheap, quick, non-invasive, easily accessible modality without radiation hazards. Our major concern is to select suspicious thyroid nodules and early detection of malignancy. Fine needle aspiration cytology (FNAC) when correlated with ultrasonographic imaging features helps inaccurate assessment of categorizing thyroid nodules. USG guided FNAC is a widely practiced procedure because it is a less time-consuming simple procedure and helps to locate suspicious sites more precisely to get a higher yield.

**Methods:** Total 70 patients with thyroid nodules detected by ultrasonography dated from October 2020 till September 2021 were enrolled in the study. The enrolled patients had FNAC in the same settings. The ultrasonographic characteristics of thyroid nodules were assessed and correlated with cytology reports.

**Results:** Amongst 70 patients, 84.3% were female and 15.7% were male with a male:female ratio of 1:1.8. The mean age was  $48.6 \pm 13.2$  years. Out of 70 patients, 49 patients had benign nodules while 21 patients had malignant nodules. Nodules that have characteristics like ill-defined border, hypoechoic echotexture, having predominantly solid components, microcalcification, increased central vascularity, and absence of halo are good indicators of malignancy. The sensitivity, specificity, positive, negative predictive value, and accuracy of ultrasonography were 72%, 91.8%, 78.9%, 88.2%, and 85.7 % respectively.

**Conclusion:** Ultrasonography is the most accurate, sensitive, and specific modality in categorizing thyroid nodules. A significant correlation of  $p < 0.05$  was observed between ultrasonography with FNAC resulting in good accuracy. There is less chance of missing malignancy which helps to reduce unnecessary surgeries and promotes surgical intervention.

**Keywords:** Biopsy, Fine-Needle; Thyroid Nodule; Ultrasonography

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## INTRODUCTION

Thyroid nodules are a common condition and are found in 3%-8% of the general population. About 10-41% of clinically unapparent thyroid nodules can be diagnosed by the help of ultrasound. Females are more commonly affected by thyroid nodules.<sup>1</sup> Malignant thyroid nodules account for 10% of nodules while 90% of them are benign. In the case of a solitary thyroid nodule, malignancy incidence ranges between 10% and 30%.<sup>2</sup> Early and accurate diagnosis of a malignant thyroid nodule is a challenging role because malignant nodules have a good prognosis after excision. Ultrasonography (USG) and fine-needle aspiration cytology (FNAC) is the most useful diagnostic modalities for assessing thyroid nodules.

USG has many advantages as it is noninvasive, lacks radiation, cheap, easily accessible modality, and helps classify, categorizing the nodules due to its superior resolution. Further, it also detects clinically inapparent nodules and can guide FNAC of thyroid nodules.<sup>3</sup> It can detect suspicious thyroid nodules that may require subsequent thorough examination and adequate treatment on time.<sup>4,5</sup>

FNAC on other hand is simple, the most accurate screening method of assessment and diagnosis of the thyroid nodules. The surgical yield of carcinoma has been roughly doubled. The number of thyroidectomies has been reduced by 50% with a reduction of overall medical cost by 25% Overall management and treatment modality of a thyroid nodule is directly influenced by cytological examination.<sup>4,5</sup>

## METHODS

A prospective study of 70 patients was conducted from October 2020 till September 2021 in the Department of Radiology of Hospital. Detailed patient information and proper clinical history were documented. Grayscale, power, and color Doppler ultrasound imaging were performed in Aplio 400 and Xario prime ultrasound Toshiba machine using 7 MHZ high-frequency transducers.

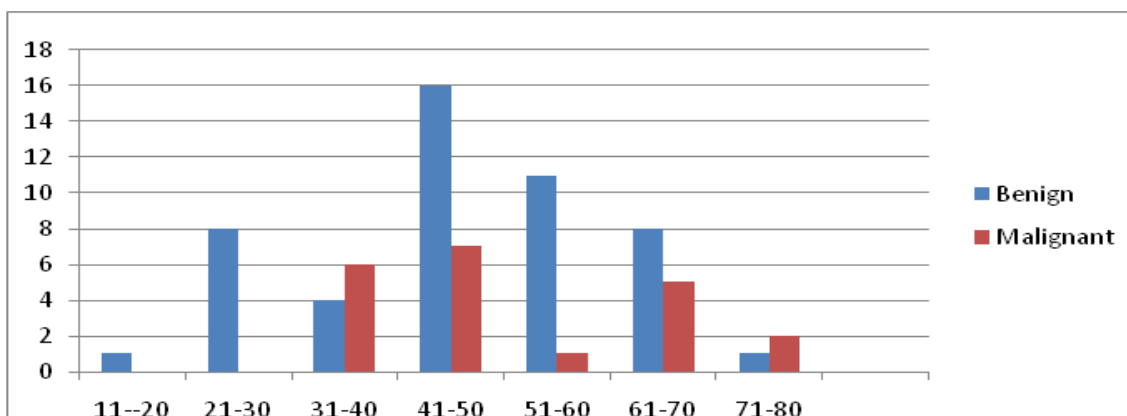
Thyroid nodules were assessed according to margin, echogenicity, calcification, internal vascularity, internal contents, circumferential halo, and associated lymphadenopathy. The margin was divided into a well-defined and ill-defined border. The echogenicity of the lesion as compared to the thyroid gland is termed hypoechoic (lower echogenicity to that of the thyroid gland), hyperechoic (more echogenic to that of the thyroid), and isoechoic (same echogenicity as that of the thyroid gland). Calcification was termed microcalcification (measuring about 10 mm) and macrocalcification (measuring more than 10 mm). The presence of central and peripheral vascularity was noted. Internal contents were recorded as solid or cystic areas within thyroid nodules. The absence or presence of circumferential halo was also documented.

FNAC of clinically apparent thyroid nodule was performed by a pathologist and under ultrasound guidance in cases of clinically inapparent nodules. It was performed by a 10 cc syringe and air-dried smears along with ether fixed wet smear were prepared. Sensitivity, specificity, positive, negative predictive values of ultrasonographic characteristics on benignity and malignancy were calculated with help of cytological examination.

## RESULTS

In a prospective study of a total of 70 patients, 59 (84.3%) were female and 11 were male (15.7%) with a male: female ratio of 1:1.8. Age was ranging from 20 to 76 years with a mean age of  $48.6 \pm 13.2$  years. Among total patients, 49 patients had benign nodules and 21 had malignant nodules. Malignancy was detected in 18 female patients and three males patients. While eight male patients and 41 female patients had benign nodules. There was a significant correlation between ultrasonographic features with FNAC reports as evidenced by a p-value of  $< 0.05$ .

In our study, there was a significant correlation between ultrasonographic and FNAC findings in the differentiation of



*Figure 1: Distribution of thyroid nodule according to age*

*Table 1: USG characteristics of thyroid nodules with FNAC result*

Parameters	Benign	Malignant	Total
<b>No. of Nodules</b>			
Single	34	17	51
Multiple	15	4	19
<b>Margin</b>			
Well defined	47	10	57
Poorly defined	2	11	13
<b>Echotexture</b>			
Hypoechoic	5	12	17
Isoechoic	18	3	21
Hyperechoic	23	0	23
Markedly Hyperechoic	3	6	9
<b>Internal content</b>			
Solid	8	9	17
Predominantly Solid	20	12	32
Predominantly Cystic	16	0	16
Cystic	5	0	5
<b>Halo</b>			
Present	25	1	26
Absent	24	20	44
<b>Calcification</b>			
Macro-Calcification	22	4	26
Micro-Calcification	4	12	16
Absent Calcification	23	5	28
<b>Vascularity</b>			
Central Vascularity	2	10	12
Peripheral Vascularity	9	2	11
Both	5	8	13
Absent	3	31	34

benign from malignant nodules as evidenced by  $p < 0.05$  calculated by Pearson's chi-square test.

**Table 2: Various USG features in diagnosis of malignant nodule**

USG Features	Sensitivity	Specificity	PPV	NPV	Accuracy
Hypoechoic	83.3%	100%	100%	71.4%	88.2%
Single Nodule	70.5%	91.9%	80%	86.1%	89.5%
Ill Defined	100%	50%	91.6%	100%	92.3%
Solid	87.5%	85.7%	87.9%	85.7%	86.6%
Absence of Halo	70%	87.5%	82.3%	77.7%	79.5%
Micro-Calcification	91.6%	50%	84.6%	66.6%	81.2%
Central Vascularity	75%	100%	100%	75%	85.7%
Overall USG	72%	91.8%	78.9%	88.2%	85.7%

**Table 3: Comparison of sensitivity, specificity of our study with various authors**

	Chinta Vittal Prasad		Sharma Gururaj		Current Study	
	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity
Ill defined margins	80%	87%	78.5%	82.3%	100%	50%
Hypoechoic echostructure	72%	88%	85.7%	67.7%	83.3%	100%
Micro-Calcifications	68%	87%	78.5%	77.4%	91.6%	50%
Absence of Halo	-	-	64.2%	53.2%	70%	87.5%
Central vascularity	64%	84%	85.7%	64.5%	75%	100%

## DISCUSSION

In our study, there was female predominance constituting 84.3% (59 cases) and male accounting for 15.7% (11 cases). A higher incidence of female patients was documented by other studies conducted by various workers.<sup>6</sup> The age group with a higher percentage of thyroid nodules was at 41-50 years similar to the study of Manoj et al. showing most of the patients in the 40-49 year age group.<sup>7</sup> The youngest age was 20 years old and the eldest was of 70 years old in our study. This finding was similar to Singh et al. who reported 18 years of age as the youngest and the oldest being 75 years.<sup>8</sup> The mean age was  $48.6 \pm 13.2$  years in our study. Gyawali et al. and Nazir et al. had mean age in little younger age which was  $38 \pm 7.3$  years and  $38.91 \pm 10.85$  years respectively.<sup>9,10</sup> In 30% of

patients had malignant nodules in our study which was a little higher than that of Chen et al. who had an incidence of malignancy of 23.5%.<sup>11</sup> Sharma et al. documented incidence of malignancy in 10.1% of thyroid nodules and Nazir et al. had still lower incidence of 6% in the study.<sup>10,12</sup> In 41-49 years age group was the most commonly affected age group with thyroid malignancy which constituted 30.4% of cases. Similarly, 41-50 years was the predominant age group among malignancy which was found in the study conducted by Singh et al.<sup>8</sup>

In a study conducted by Brown, thyroid malignancy was encountered in a single thyroid nodule and none of the multiple nodules had evidence of malignancy.<sup>13</sup> In our study, multiple nodules accounted for 27% similar to Brown, out of which 21.6% were

benign and 5.4 % were malignant.

About 62% of hypoechoic nodules were malignant in a study reported by Solbiati et al.<sup>14</sup> Similarly in our study, the incidence of malignancy was more prevalent in hypoechoic nodules and benign lesions were commonly encountered in hyperechoic followed by isoechoic nodules. 57.1% of cases with hypoechoic echotexture had malignant nodules and 46.9% of nodules with hyperechoic echotexture had benign entities in our prospective study. Usually, macrocalcification which is large, nodular, coarse is predictive of benign variety, and fine, punctate calcification comprises malignant variety. Punctate calcification is usually the result of psammoma bodies of papillary thyroid carcinoma. Singh et al. reported in their study that calcification was found in 9 cases (18%) out of 50 patients. Nodular calcification was seen in 33.33% of cases.<sup>8</sup> Out of which, 22.22% cases were benign and 11.11% cases were malignant. Similarly, 33.33% of cases had fine calcification. Out of which, 22.22% cases were malignant and 11.11% cases were benign. All the cases with coarse calcification, which accounted for 33.33%, were benign in his study.

In total, 42 (60%) out of 70 patients had calcification in thyroid nodule in our prospective study. Among which, 61.9% % had macrocalcification, out of which 52.8 % were benign and 9.5% were malignant; 38% had microcalcification, out of which, 9.5% were benign and 28.5% were malignant. Thus our study also clearly demonstrated that microcalcification is a predictive sign of malignancy similar to Singh et al.<sup>8</sup>

A thin, complete peripheral halo, usually represents blood vessels around the periphery of the lesion which is highly predictive of benign nodules. Peripheral halo was present in 36% of cases in a study by Singh et al. and all of them were benign. Halo was reported in 36% of thyroid nodules in a study by Solbiati et al. and 86% accounted for benign and 14% comprised for malignant abnormality.<sup>8,14</sup>

Similarly, in our study, 37.1% had the presence of a halo. Out of this, 96.1% accounted for benign nodules and 3.8 % accounted for malignant nodules.

In a study by Singh et al., 10% of cases of thyroid nodules with irregular margins showed that all of them were malignant.<sup>8</sup> Solbiati et al. reported that 55% of thyroid nodules with irregular margins were malignant.<sup>14</sup> However, in our study, 15.7% of nodules with an ill-defined margin had malignancy.

The sensitivity, specificity, positive predictive value, and negative predictive value of ultrasonography when correlated with FNAC were 64%, 81%, 53%, and 87% respectively in a study by Prasad CV.<sup>15</sup>

In a study by Kapali et al. the sensitivity of ultrasound in diagnosing malignant nodules was 88.4%, specificity was 73.3% and the overall accuracy was 80.3%.<sup>16</sup>

Our prospective study demonstrated an overall sensitivity of 72%, specificity of 91.8%, the positive predictive value of 78.9%, the negative predictive value of 88.2%, and accuracy of 85.7% of ultrasonography in detecting malignant nodules. Our sensitivity was lower than that of Kapil et al. as there were some overlapping ultrasonographic features of the malignant nodules and that of the benign nodules. However overall accuracy was a little higher than that of Kapil et al.<sup>17</sup> Irregular border, hypoechoic echotexture, absence of halo, solid content with marked central vascularity, microcalcification were the important ultrasonographic hallmark features of malignancy. FNAC is the gold standard diagnostic mode of detecting malignant nodules. However, there are certain limitations in cases of inadequate and indeterminate samples. About 4-15% of all cases had undetermined results even inadequate samples. So there are chances of false positive and false-negative cases.<sup>18</sup> However, there was a significant correlation between ultrasonographic and FNAC findings in differentiation benign from malignant nodules, as evidenced by  $p < 0.05$  in our

overall study. Similarly, it also documented that ultrasonographic features in diagnosing malignancy had statistically significant p-value < 0.05.<sup>19</sup>

## CONCLUSION

Ultrasonography is the most accurate and specific modality in differentiating benign from malignant nodules and is the best imaging modality after clinical examination due to the superficial location of the thyroid gland. The combination of ultrasonography with FNAC, rather than a single modality, helps detect malignant nodules and timely surgical intervention. In addition, ultrasound also allows visualization of whole thyroid glandular parenchyma and local invasion to adjacent neighboring structures along with cervical lymphadenopathy in suspicious cases.

## CONFLICT OF INTEREST

None

## SOURCES OF FUNDING

None

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