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Original Research Paper

Radio-Diagnosis

ROLE OF SONOGRAPHY IN CHARACTERIZATION OF THYROID NODULES FOR DIFFERENTIATING BENIGN FROM MALIGNANT

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ABSTRACT

Background: Thyroid nodules are a common entity found in about 4-8% of adults by palpation, 41% by ultrasound and 50% at autopsy according to studies done. A minority of these, less than 5% are malignant. Ultrasound has over the decades played an important role in the diagnostic evaluation of thyroid disease mainly because of the gland's superficial location, availability and cost effectiveness of the ultrasound examination. We aimed to use ultrasonographic criteria to differentiate benign and malignant thyroid nodules and correlate with fine-needle aspiration cytology (FNAC) findings. **Settings and Design:** It is a cross-sectional study carried out in 100 patients who had undergone USG for thyroid nodule during March 2021 to December 2021. For the purpose of establishing a diagnosis and validating the ultrasound results, these cases underwent FNAC. The nodules were surgically removed, and a specimen was sent for histological analysis to distinguish between follicular adenoma and follicular carcinoma, according to the FNAC diagnosis of follicular neoplasms. **Results:** Six of the 100 nodules tested were cytopathologically determined to be malignant. The malignant nodules had a solid or mostly solid composition (sensitivity 100%, specificity 49.5%), absence or thick incomplete halo (sensitivity 92%, specificity 72.9%), microcalcification (sensitivity 91.7%, specificity 66.7%), a markedly hypoechoic character (sensitivity 85%, specificity 83.7%), irregular or poorly defined margins (sensitivity 83.3%, specificity 92.5%) and anteroposterior diameter greater than transverse diameter (sensitivity 65%, specificity 93%). **Conclusions:** To differentiate between benign and malignant thyroid nodules, ultrasonography (USG) features are helpful. thyroid tumors It is clear from our study that the USG findings of poorly defined margins, noticeable hypo echogenicity, and A taller-than-wider form, a thin or thick irregular peripheral halo, and microcalcifications all have good diagnostic accuracy for recognizing thyroid nodules that are cancerous.

KEYWORDS : Thyroid nodule, Sonography, Fine-needle aspiration cytology

INTRODUCTION:

According to studies, thyroid nodules are a frequent item discovered in roughly 4-8% of individuals by palpation, 41% by ultrasound, and 50% at autopsy. Less than 5% of these, a minority, are malignant.[1,2] Iodine deficient areas, females, advancing age, and radiation exposure are all associated with an increased risk of thyroid nodules. To enable early treatment of thyroid cancer patients, it is necessary to screen thyroid nodules to identify those that are more likely to be malignant.[2] The frequency of thyroid nodules has increased over the past 20 years, and the prevalence rate varies between studies due to the extensive use of ultrasonography for the evaluation of thyroid and non-thyroid neck diseases.[3-5]

In 1967, ultrasound was used to study the thyroid gland for the first time, primarily to distinguish solid lesions from cystic lesions.[6] Due to the thyroid gland's superficial location, availability, and cost-effectiveness of the ultrasound examination, ultrasound has since played a significant role in the diagnostic evaluation of thyroid disease. Using high resolution real time grey scale (B-mode) and colour Doppler sonography, normal thyroid architecture and pathologic abnormalities are shown with astounding clarity.

The diagnostic method for surgical and non-surgical goiters, fine needle aspiration cytology (FNAC), is now a well-established, first-line screening test that is rapid, easy, and straightforward to perform. The main reasons why FNAC is limited are insufficient sampling, the pathologist's lack of experience, and overlapping cytological features.[7] It is crucial that thyroid nodules are classified into benign and malignant nodules by USG in conjunction with FNAC because this aids in the ongoing management of patients with nodular thyroid disease. Therefore, the current investigation is carried out to determine the effectiveness of USG in the evaluation of thyroid nodules.

METHODOLOGY

A cross-sectional study was conducted after approval of institutional ethical committee. The study was conducted in the department of Radio diagnosis of KVG Medical college and hospital., Sullia, Dakshina Kannada, Karnataka, India. The study was conducted for 6 months. Sample size calculation was calculated using the following formula:

$$n = \frac{NZ^2P(1-P)}{d^2(N-1)+Z^2P(1-P)}$$

A total of 240 patients were anticipated to be referred to the radiology department during the six-month research period for ultrasonographic examination of thyroid nodules. Based on an analysis of monthly records at the radiology department, we estimated that 75% (n = 180) of these referrals would qualify for the study after exclusion criteria were considered. With a desired precision of 5% and an expected proportion of investigated patients with malignant nodules on ultrasonography investigation of 11.5%, the calculated sample size was 84 inflated to 100.

We included 100 adult patients aged more than 18 years refereed to radiology department for ultrasound evaluation of thyroid nodule who had sent their thyroid sample for biopsy and give consent to participate in our study. We exclude patients with diffuse thyroid enlargement.

All the patients were evaluated by thorough clinical examination. Ultrasound of neck was done in our department in all cases using high-frequency linear array Ultrasound transducer. The study was conducted gray-scale real-time ultrasound examination was done using 7.5 MHz linear array transducer. Ultrasound machines used were VOLUSON S8.

The patient was examined while lying on his back with his neck extended. To provide for improved neck exposure, a pillow was positioned under the shoulders. A 7.5 MHz linear array transducer was employed because the gland is located superficially.

In the longitudinal and transverse planes, the entire thyroid

gland, including the isthmus and both poles, was evaluated. The supraclavicular fossa, jugular veins, and bilateral carotid arteries were also looked at. For the purpose of establishing a diagnosis and validating the ultrasound results, these cases underwent FNAC. All 120 subjects underwent FNAC thyroid under aseptic conditions. The 23G needle was used for FNAC, and Hematoxylin and Eosin stains were used to fix and colour the smears (H&E). Results from the USG and cytology were compared and examined.

The data recorded was analyzed using the Statistical Package for Social Sciences (SPSS), 21 version. The associations were evaluated with the use of Student's t-test for quantitative variables and $\chi 2$ tests for categorical variables. The level of significance was set at 5% for all significance tests. The sensitivity, specificity and accuracy for each of the findings were calculated.

RESULTS

In our study we considered following any two features in a thyroid nodule as malignant:

1. Shape of the nodule to be taller than wide
2. Marked hypo-echogenicity
3. Microcalcifications
4. Poorly defined margins
5. Absent or irregular thickened discontinuous peripheral halo

The sonographic standards used in this study were based on standards which has been published.[8-11] By using ultrasound to examine 100 thyroid nodules, we discovered that 11 of them met the criteria for a malignant diagnosis, while the remaining 89 were benign. Six of the 100 nodules that underwent FNAC evaluation were confirmed to be cancerous, whereas 94 were benign.

In our study, majority of thyroid nodule case were aged between 41 to 50 years with female preponderance (84%) (Table 1).

Table 1: Age and gender distribution

Parameters		Frequency
Age	18 to 30 years	12
	31 to 40 years	26
	41 to 50 years	44
	51 to 60 years	11
	> 61 years	7
Gender	Males	16
	Females	84

The majority of the malignant thyroid nodules in our study had poorly defined margins, presence of calcifications (microcalcifications), absence of peripheral halo, having predominantly solid internal contents, markedly hypoechoic with shape taller than wide.

Majority of the benign thyroid nodules are having well defined margins, without calcifications, thin and continuous peripheral halo, predominantly solid internal content, having shape not taller than wide. All hyperechoic, isoechoic, and majority of hypoechoic nodules are benign (Table 2).

Table 2: Comparison of pre-operative and post-operative vitals in study groups.

USG Characteristics		Benign	Malignant
Margin	Well defined	74	2
	Poorly defined	20	4
Calcification	Present	25	4
	Absent	69	2
Peripheral halo	Thin and continuous	74	1
	Absent or thick and regular	20	5
Internal contents	Solid/ Predominantly solid	55	6
	Predominantly cystic	9	0
	Purely cystic	12	0
Echogenicity	Hyperechoic	28	0
	Isoechoic	31	0
	Hypoechoic	14	2
	Markedly hypoechoic	5	4
Shape	Taller than wide	19	4
	Not taller than wide	75	2

We found that, on FNAC a total of 94 cases were diagnosed as benign thyroid nodule and 6 thyroid nodules were reported as malignant (Figure 1)

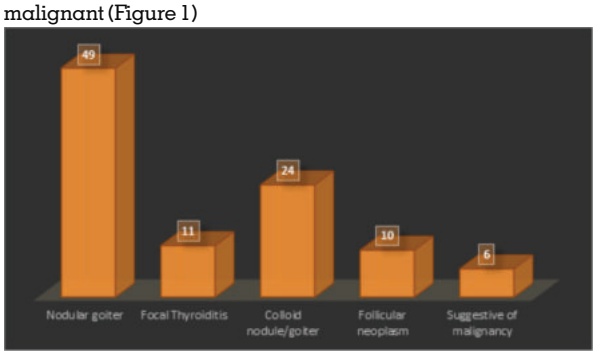


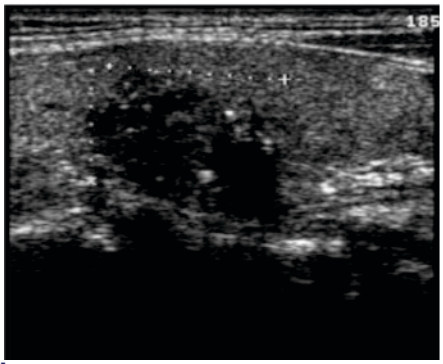
Figure 1: Cytopathology - FNAC diagnosis of the cases

Table 3 shows the sensitivity and specificity for each of the findings. A solid or predominantly solid nodule, absent halo sign, presence of calcifications, hypoechogenicity, ill-defined or irregular margin and a taller-than-wider shape were the decreasing order of sensitivity for distinguishing malignant from benign nodules.

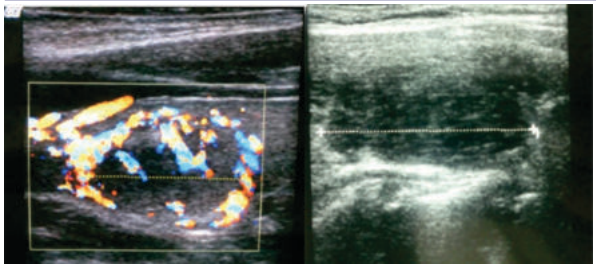
Table 3: Diagnostic accuracy of USG features in malignant thyroid nodules.

USG feature	Sensitivity	Specificity
Solid/predominantly solid	100%	49.5%
Hypoechogenicity	85%	83.7%
Taller-than-wider shape	65%	93 %
Ill-defined margins	83.3%	92.5%
Absent halo sign	92%	72.9%
Calcification	91.7%	66.7%

1. Follicular adenoma



2. Papillary cancer



3.Increased Vascularity Microlobulations

4. Taller than Wider Hypoechoic and irregular margins

DISCUSSION

A thyroid nodule is described as a distinct area of abnormality in the context of a thyroid gland that is otherwise normal.[12] The most frequent reason for thyroid ultrasound referrals is thyroid nodules, which are widespread.

Our study included 100 cases of thyroid nodules. We reported female preponderance similar to studies by Khainga et.al.[13], Sharma et al.[14], Bairi et. al.[15], Banstola et. al.[16] and Chinta et. al.[17]

We also noted that the frequency of thyroid nodules increased with increasing age, peak age being between 41 to 50 years. This was comparable to study by Bairi et. al.[15]

To distinguish between benign and malignant thyroid nodules during the initial workup, ultrasonography is the preferred technique.[18,19] Predominantly solid component, hypo-echogenicity, microcalcifications, taller-than-wider form, uneven edges, internal vascularity, and absence of peripheral halo are USG characteristics that are worrisome for malignancy.[12,18,20,21]

Malignancy has been studied as a marker for the nodule's shape. In the current study, the majority of the malignant nodules displayed a shape that was taller than wide. When a nodule has significantly less echotexture than the nearby neck strap muscles, it is said to be severely hypoechoic. Given the high prevalence of benign lesions, previous similar studies have shown that most malignancies exhibit a hypoechoic nodule.[21-25] Microcalcifications are seen sonographically as multiple punctate bright echoes that are 2 mm in size, with or without acoustic shadowing.[26] When more than 50% of a thyroid nodule's margin is not clearly defined, it is considered to be poorly defined.[12,20]Spiculated margins that are poorly defined or irregular are typical of malignant lesions. A hypoechoic halo known as the peripheral halo, which is most frequently seen in benign thyroid nodules and represents the blood vessels circling the lesion, surrounds the thyroid nodule. Typically, the peripheral halo is full and narrow. Due to the rapid growth of the tumour, it is believed to represent squeezed normal tissue since it is uneven, thick, partial, or absent in a malignant nodule.[27] The majority of research have indicated limited sensitivity and specificity for determining whether a halo is present or not.[22,28]

Following is the table of comparison of sensitivity of USG features in malignant thyroid nodules with other studies. From the above table, it is clear that our study results were comparable to studies by Avinash et.al.[29], Gururaj Sharma et.al.[14] and Manju Bala Popli et.al.[22] Studies by Young Hun Lee et.al.[23] and Eun-Kyung Kim et.al.[24] reported lower diagnostic accuracy compared to our study

	Solid/ predominantly solid	Hypo-echogenicity	Taller-than-wider shape	Ill-defined margins	Absent halo sign	Calcification
Our study	100%	85%	65%	83.3%	92%	91.7%
Avinash et.al.29	100%	66.66%	50%	83.33%	83.33 %	66.66%
Gururaj Sharma et.al.14	100%	85.7%	64.2%	78.5%	64.2 %	78.5%
Manju Bala Popli et.al.22	88.6%	65.9%	77.2%	84%	70.4 %	65.9%
Young Hun Lee et.al.23	-	64%	64%	69%	-	44%
Eun-Kyung Kim et. al. 24	-	26.5%	32.7%	55.1%	-	59.2%

CONCLUSION

USG is a sensitive and specific modality for assessing thyroid nodules with good overall accuracy in differentiating benign from malignant thyroid nodules. While FNAC/HPE remains the gold standard for establishing the final diagnosis. The most useful indicators of malignancy in this study were a solid composition, absence of peripheral halo and presence of calcifications.

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