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GRAY-SCALE ULTRASOUND TO DIFFERENTIATE BENIGN FROM MALIGNANT THYROID NODULES

Radiodiagnosis

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ABSTRACT

Objective: The objective was to assess the utility of gray-scale USG to identify patterns of thyroid nodules and to correlate the characteristics of benign and malignant nodules with pathological diagnosis.

Materials and Methods: From March2018 to August 2018, a total of 100 patients (15 males and 85 females), with 150 nodules detected at USG, were included in this study. The characteristics of each nodule were determined. The results were then compared with fine needle aspiration (FNA)/histopathological diagnosis.

Results: Of the 150 nodules examined, 25 (16.66%) were found to be malignant on cytopathology. The malignant nodules demonstrated solid or predominantly solid composition; presence of microcalcification; irregular or poorly defined margins; anteroposterior (AP) diameter > transverse diameter; absent or thick incomplete halo and markedly hypoechoic character. Among males, malignant nodules were found in 36.8%, whereas in females the occurrence was 16.7%.

Conclusion: Gray-scale USG features of thyroid nodules are useful to distinguish patients with clinically significant thyroid nodules from those with innocuous nodules despite the overlap of findings. From our study, it is apparent that the USG findings of poorly defined margins, marked hypoechogenicity, microcalcifications, and a taller-than-wider shape have a high diagnostic accuracy for identifying malignant thyroid nodules.

KEYWORDS

INTRODUCTION

Nodular thyroid disease is detected in 3–7% of the adult population worldwide. The majority of these cases are clinically occult but readily detected by high-resolution Ultrasonography (USG). [1-4] Thyroid cancer is rare and accounts for <1% of all malignant neoplasms. It has a good long-term prognosis after surgical excision. The high prevalence of thyroid nodules in the general population calls for a clear strategy to identify patients in whom surgical excision is genuinely indicated as opposed to those who can be managed conservatively.[2] Current management guidelines (American Thyroid Association) state that diagnostic USG should be performed in all patients with thyroid nodules and fine needle aspiration (FNA) in potentially malignant nodules.[3] Various features seen on USG, such as irregular margins, hypoechogenicity, absence of a surrounding halo, calcifications, and solid internal composition, have been investigated as predictors of malignancy.

The purpose of this study was to assess the utility of grayscale USG in evaluating thyroid nodules and to correlate the characteristics of benign and malignant nodules with the pathological diagnosis.

MATERIALS AND METHODS

Patients from March 2018 to August 2018, a total of 100 patients with clinically palpable nodules referred from the different outpatient departments of our institute were included in this study. Of these, 15 were males and 85 were females. In all, 150 nodules were detected and evaluated sonographically in these patients, and all patients then proceeded for an FNA exam. The patients were in the age range of 15–62 years. A thorough clinical history was obtained. Investigations to be performed were explained to each patient .

USG examination: All USG examinations were performed with LOGIQ P3 GE HEALTHCARE unit using 5--12 MHz transducer or with a 7.5 MHz transducer.

USG features of each thyroid nodule were assessed. The 150 nodules in 100 patients were evaluated for their margins, shape, echogenicity, presence of calcification, presence of circumferential halo, and internal composition.

The margins were assessed as smooth or irregular (further subclassified as lobulated or poorly defined) and whether surrounded by a peripheral halo or not [Figures 1 and 2]. The echogenecity was assessed as hypoechoic, hyperechoic, isoechoic or anechoic in comparison to normal thyroid parenchyma [Figure 3]. The hypoechoic nodules were further subclassified as markedly hypoechoic if less echogenic than strap muscles. The nodules were also categorized as solid, predominantly solid (<50% cystic change), predominantly cystic (>50% cystic change) or cystic based on their composition [Figures 4 and 5]. The presence of calcification as well as type of calcification whether micro- or macro-calcification was noted [Figures 6 and 7]. The shape was determined by measuring the antero-posterior diameter to transverse diameter ratio on transverse USG images [Figure 8].

If a patient had several thyroid nodules, each thyroid nodule was classified separately. A diffusely enlarged thyroid gland with multiple nodules and no intervening normal parenchyma was classified as multinodular goiter 73 patients with these findings were excluded from the study. Nodules less than 1 cm in size were also excluded

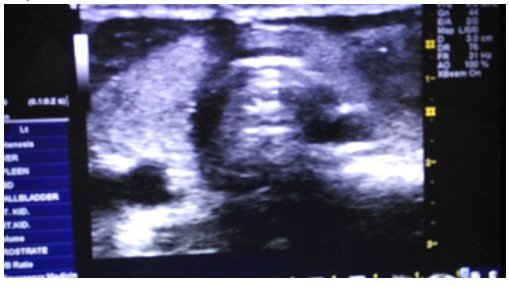


Figure 1: Margins. Longitudinal USG image (A) of the left lobe of the thyroid gland shows a hypoechoic nodule (arrows) with poorly defined margins and microcalcifications (arrowheads). The FNA diagnosis was papillary carcinoma.

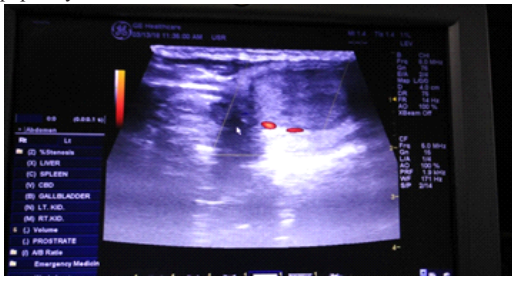


Figure 2: Peripheral halo. USG image of the right lobe of the thyroid gland shows a hypoechoic to isoechoic nodule (arrow) with a surrounding, thin, regular, complete, hypoechoic halo (arrowheads) in the right lobe of the thyroid gland.



Figure 3: Echogenecity. Longitudinal USG scan of the left lobe of the thyroid gland shows a well-defined isoechoic nodule

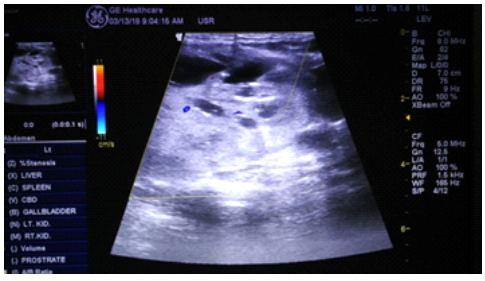


Figure 4: Calcifications. USG image shows macrocalcification with distal shadowing along the periphery in a heterogeneous nodule in the left lobe of the thyroid gland. The FNA result was hyperplasic nodule.

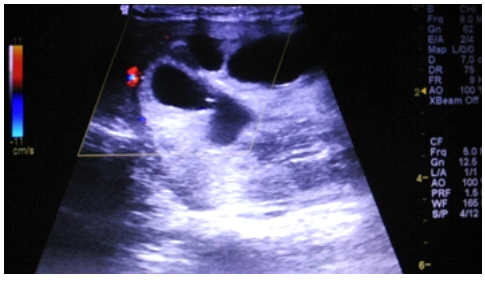


Figure 5: Internal composition. USG scan of the left lobe of the thyroid gland shows predominantly cystic nodule

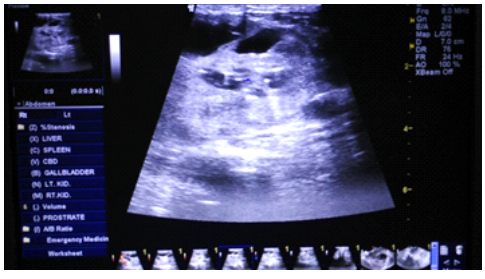


Figure 6: Calcifications: USG scan (B) of the right lobe of the thyroid gland shows multiple foci of calcification (arrowheads) within a nodule (arrow) classified as the "not-otherwise-specified" variety of macrocalcification. The pathologic diagnosis was hyperplastic nodule,from this study, since the recommended minimum size for ultrasound guided FNA is 1.5 cm.[5] Purely cystic nodules were not subjected to FNA.

Pathologic evaluation All FNAs were performed under USG guidance. The cytopathology result was considered as the final diagnosis. Tissue diagnosis was available for 54 of the surgically resected nodules. Fourteen of these nodules for which FNA was inadequate and those that could not have a tissue diagnosis were not included in the study.

RESULTS

Of the 150 nodules evaluated at USG, 35 were diagnosed to be malignant, 81 benign, and 19 were labeled suspicious for malignancy. After histopathological evaluation, 44 (29.33%) of the 150 nodules were found to be malignant and 106 (70.66%) were benign. Fifteen of the suspicious nodules were follicular neoplasms, while nine were subsequently diagnosed as follicular carcinomas at histopathology after surgical resection and six as adenomas. The remaining malignant nodules were diagnosed as papillary carcinomas in 32 patients and medullary carcinomas in 3 patients. In males, 40% (6/15) of the nodules were found to be malignant, whereas in females malignancy was seen in 16.47% (14/85) nodules.

The majority of the malignant lesions (37/44) had irregular, lobulated, or poorly defined margins. None of the nodules with cystic/ predominantly cystic composition were found to be malignant. Most malignant nodules (34/44) demonstrated a taller-than-wide shape in comparison to benign nodules. Although the majority of the hypoechoic nodules were found to be benign, none of the hyperechoic nodules were malignant. Calcification occurred with greater frequency in malignant nodules, i.e., in 86.3% (38/44) malignant nodules vs. 24.52% (26/106) benign nodules. Thyroid nodules with calcification were classified into those with microcalcifications and those with macrocalcifications. In our series, nodules with microcalcifications were found to be malignant in 87.8% cases, while those with macrocalcifications were found to be malignant in 17.3% cases [Table 1].

The sensitivities and specificities for each USG characteristic of thyroid nodules were determined. Poorly defined margins, marked hypoechogenicity, and a taller-than-wide shape were found to have a high diagnostic accuracy for distinguishing malignant from benign thyroid nodules [Table 2].

Table 1: Various USG features of benign and malignant thyroid nodules Fine needle aspiration

	Malignant	Benign	Total
Gender			
Female	14	71	85
Males	6	09	15
Margin			
Smooth	2	60	62
Lobulated	20	01	21
Poorly defined	17	00	17
Calcification			
Present	46	14	60
Absent	5	35	40
Internal Contents			
Solid	14	19	33
Predominantly solid	3	20	23
Predominantly cystic	2	40	42
Cystic	0	2	2
Peripheral Halo			
Present, thin and regular	06	54	60
Absent or thick and irregular	25	15	40
Echogenecity			
Hyperechoic	0	2	02
Hypoechoic (excluding markedly hypoechoic nodules)	33	07	40
Markedly hypoechoic	02	52	54
Isoechoic	0	1	01
Anechoic	0	1	1
Shape			
Taller than wide	34	10	44
Not taller than wide	5	51	56

Table 2: Comparison of ultrasound with Fine needle aspiration/ histopathology

Fine needle aspiration/ histopathology			
	Malignant	**Benign**	**Total**
USG			
Malignant	35	25	60
Benign	9	81	90
Total	44	106	

DISCUSSION:

Thyroid nodular disease is characterized by the presence of one or more palpable or nonpalpable nodules within the substance of the thyroid gland. A thyroid nodule is defined as a discrete lesion within the thyroid gland that is distinguishable from the adjacent parenchyma at USG.[4]

We found an overall higher percentage of malignant nodules in our series (18.33%) than has been previously reported in other

studies.[1,5]. As thyroid problems are much more common in women than men, this is probably the reason for the increased incidence found in women, in our series.

When more than 50% of the margin of a thyroid nodule is not clearly defined it is considered as poorly defined. [5, 6] Malignant lesions tend to have poorly defined or irregular margins, whereas benign thyroid nodules tend to have sharp well-defined margins. We found ill-defined or irregular margins for diagnosing malignant nodules seen in 37 out of 44 malignant cases [5, 7] amongst all the USG characteristics for diagnosing malignant nodules. Our experience shows that calcification occurs more commonly in malignant nodules (38/44) than in benign nodules (26/106). Also, the occurrence of malignancy was more common in nodules with calcification than in those without. We assessed nodules for presence of micro- as well as macro calcification. Micro calcifications are seen sonographically as multiple punctate bright echoes that are less than 2 mm in size, with or without acoustic shadowing. As categorized by Kim et al., [8] among the macro calcifications were solitary calcifications (hyperechoic foci, >2 mm linear or round structures within the nodule or encircling less than 1/3rd of the nodule's margin), eggshell calcification (curvilinear hyperechoic shadow that extends along the margin of the nodule for more than 1/3rd of its circumference), and the not-otherwise-specified (NOS) variety (comprising the rest). Microcalcifications were found to be a highly specific USG feature of malignant thyroid nodules.

Moon et al. categorized the internal composition of a nodule according to the ratio of the cystic portion to the solid portion in the nodule; thus, the nodule could be predominantly solid (<50% cystic) or predominantly cystic (≥50% cystic). [9] Using the same criteria, our analyses showed that most thyroid nodules were solid or predominantly solid rather than cystic or predominantly cystic. The study indicates that most malignant nodules are solid or predominantly solid; however, most solid or predominantly solid nodules are benign.

A peripheral sonolucent halo surrounding the thyroid nodule represents blood vessels coursing around the lesion in a benign nodule. This halo is usually complete and thin. The irregular, thick, and incomplete halo seen around a malignant nodule is thought to represent compressed normal tissue due to rapid growth of the tumor.[1] Though in a recent series[10] the absence of a halo was the sign that was most predictive of malignancy on conventional USG, most studies have reported a low sensitivity and specificity for the presence or absence of a halo.[5,7] Our study demonstrated absent or thick, irregular halo to be 62%, , making it an insignificant marker of malignancy.

Current studies have revealed that most malignancies demonstrate a hypoechoic nodule, yet most hypoechoic nodules are benign in view of the high prevalence of benign lesions.[11] In our series also, most of the malignant nodules (33/44) were hypoechoic in appearance, though the majority of the hypoechoic nodules were benign (52/81). In contrast, none of the malignant nodules were found to be purely hyperechoic or anechoic. Kim et al. [12] defined a markedly hypoechoic nodule as one that is hypoechoic to the strap muscles anterior to the thyroid gland. We found two marked hypoechogenic malignant thyroid nodules. The USG feature of marked hypoechogenecity indicates that nodules that are not markedly hypoechoic are likely to be malignant in only about 3.7% of cases.

The shape of the nodule has also been studied as a marker of malignancy. The width of the nodule on a transverse scan corresponds to the natural growth planes. Malignant tumors have a tendency for centrifugal growth and show expansion perpendicular to the natural growth plane.[13–15] The appearance at USG is of a nodule that is taller than wide (i.e., anteroposterior diameter > transverse diameter on transverse scan). In 2006, Cappelli et al. in their series concluded that a taller-than-wide shape was a useful criterion for identifying a malignant lesion.[15] Popowicz et al. indicated hypoechogenicity, the presence of microcalcifications, and the shape (with height-to-width ratio >1) to be independent features suggestive of malignant lesions, irrespective of their size.[14] In the present study, we measured the anteroposterior (AP) and transverse (T) diameters and found AP≥T to be specific for 77.27%.

In conclusion, gray-scale USG features of thyroid nodules are useful to identify patients with clinically significant thyroid nodules from those with innocuous nodules. In our study, the USG features of poorly defined margins, marked hypoechogenicity, and taller-than-wide shape were found to have high diagnostic accuracy for identifying malignant thyroid nodules.

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