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The value of ultrasound examination in Iraqi patients with thyroid nodules: a cross-sectional study

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Abstract

Background: Nodules in the thyroid gland are frequently seen in the general population, and the rate of their detection is becoming increasingly higher with the current use of ultrasound examination for evaluating thyroid diseases. Some parameters, seen during an ultrasound examination, have been suggested to be associated with increased risk of thyroid malignancy; these include hypoechogenicity, microcalcifications, increased intranodular vascularity, nodule shape or irregular margins and absence of a halo.
The aim of the study: evaluation of the ultrasound role in a sample of Iraqi patients with thyroid nodules.
Patients and methods: The current cross-sectional study included 112 patients with thyroid nodules. Each patient was evaluated by ultrasound examination for the following parameters: Poorly defined margin, microcalcification, the absence of peripheral halo, taller than full shape, the presence of internal vascularity stable configuration and Hyo-echoic pattern.
Results: The sensitivities of these parameters were 72.7, 72.7, 81.8, 36.4, 90.9, 90.9 and 90.9 %, respectively. The specificities of these parameters were 90.1, 81.2, 8.9, 93.1, 4.4, 9.9 and 84.2 %, respectively. The most sensitive parameters were internal vascularity, solid pattern, and hypoechogenicity. The most specific parameters were taller than wide shape, poorly defined margin and hypoechogenicity; hover markers with the best combinations regarding sensitivity and specificity were poorly defined margin, calcification, and hypoechogenicity. When the number of features included in malignancy prediction was increased, the sensitivity was higher; however, the specificity became lower. The combined sensitivity of poorly defined margin, calcification and hypoechogenicity was 100%.
Conclusion: When the number of features included in malignancy prediction was increased, the sensitivity was higher; however, the specificity became lower. The combined sensitivity of poorly defined margin, calcification and hypoechogenicity was 100%.

Keywords: ultrasound features, thyroid nodules

INTRODUCTION

Nodules in the thyroid gland are frequently seen in the general population, and the rate of their detection is becoming increasingly higher with the current use of ultrasound examination for evaluating thyroid diseases. The rate of detecting thyroid nodule is in the range of 19 to 67 %, and it was reported that the rate of detecting thyroid nodules becomes significantly more with increasing age reaching more than 50% in people older than 50 [1-4]. From a clinical point of view, the most important target when facing a thyroid nodule is to exclude malignancy. The rate of malignancy in thyroid nodules ranges from 5 to 15 % in different clinical settings regarding the age of the patient, gender, exposure to radiation and other risk factors [4-6]. During the last five decades, the rate of thyroid malignancy increases five times, and this is attributable mainly to increased detection of papillary thyroid carcinoma which is mostly of excellent prognosis [7]. Some parameters, seen during an ultrasound examination, have been suggested to be associated with increased risk of thyroid malignancy; these include hypoechogenicity, microcalcifications, increased intranodular vascularity, nodule shape or irregular margins and absence of a halo [8]. Nevertheless, it seems that no single parameter can sufficiently alone be reliable to predict malignancy in thyroid nodules. Diagnostic sensitivity ranges from 26.5% to 87.1% for hypoechogenicity, 54.3% to 74.3% for intranodular vascularity, and 26.1% to 59.1% for microcalcifications, whereas specificity ranges from 43.4% to 94.3%, 78.6% to 80.8%, and 85.8% to 95%, respectively [2, 8, 9]. One recent ultrasound parameter is elastography (US estimation of tissue elasticity) has been suggested to correlate with malignancy in the setting of a thyroid nodule. The sensitivity of this parameter in a meta-analysis study was estimated to be 92% and its specificity to be 90%, but, the number of studies which were selected to carry out the meta-analysis was unfortunately low and a few studies incorporated histopathology for definite characterization of thyroid nodules [10]. Indeed, tissue examination is the standard gold technique to establish diagnosis with certainty in patients with thyroid nodules, and fine needle aspiration cytology (FNAc) stands nowadays as the standard mode of tissue examination method in these clinical settings; however, it has its limitations, and surgical biopsy is extremely costly if considered in all cases of thyroid nodules. Indications to perform thyroid biopsy are now well defined and may include terms such as “positive family history, radiation exposure and suspicious ultrasound examination”; [4, 8] however, there is no clear incite about the probability of the US features associated with malignancy and which combination would be more clinically useful. In the field of FNAc there is a category of patients that are going to be labeled with either inadequate sample for diagnosis (10 percent) or malignant potential is suspicious but not definite (15 to 30 percent); the risk of malignancy in the latter group being sufficiently high, so the implementation of reliable ultrasound parameters may help to reach final diagnosis or at least to take a decision in these situations [3, 4]. The sensitivity of ultrasound in diagnosing malignancy has been estimated recently to range from 26 to 87 % and specificities to range from 40 to 93% [11]. The presence of sufficient controversy in the available published literature about the role of ultrasound in predicting malignancy in the clinical setting of thyroid nodules beside the very low number of Iraqi studies dealing with this subject justified the conductance of the present study aiming at evaluation of the ultrasound role in a sample of Iraqi patients with thyroid nodules.

PATIENTS AND METHODS

The current cross-sectional study included 112 patients with thyroid nodules. The study was carried out at my private and outpatient clinics Al-Diwaniyah Teaching Hospital, Al-Diwaniyah province, Iraq, starting in January 2017 and ending in January 2018. Each patient was evaluated by ultrasound examination for the following parameters: Poorly defined margin, microcalcification, the absence of peripheral halo, taller than wide shape, the presence of internal vascularity solid configuration and hypo-echoic pattern.

Statistical analysis was carried out using the statistical package for social sciences (SPSS) version 23. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of each ultrasound parameter was assessed in isolation and also in combination.

RESULTS

Table 1 showed the sensitivity, specificity, positive predictive value, negative predictive value and accuracy of each ultrasound feature in isolation. Poorly defined margin, microcalcification, the absence of peripheral halo, taller than wide shape, the presence of internal vascularity solid configuration and Hyo-echoic pattern

were the main features tested. The sensitivities of these parameters were 72.7, 72.7, 81.8, 36.4, 90.9, 90.9 and 90.9 %, respectively. The specificities of these parameters were 90.1, 81.2, 8.9, 93.1, 4.4, 9.9 and 84.2 %, respectively. The most sensitive parameters were internal vascularity, solid pattern, and hypoechogenicity. The most specific parameters were taller than wide shape, poorly defined margin and hypoechogenicity; hover markers with the best combinations regarding sensitivity and specificity were poorly defined margin, calcification, and hypoechogenicity. Table 2 showed the sensitivity and specificity of ultrasound features in combination. When the number of features included in malignancy prediction was increased, the sensitivity was higher; however, the specificity became lower. Table 3 showed that the combined sensitivity of poorly defined margin, calcification and hypoechogenicity was 100%. Distribution of patients according to age and gender is shown in table 4.

Table 1: Sensitivity and specificity of each ultrasound parameter in prediction of malignant thyroid nodule

Characteristic		Total	Malignant	Benign	Sensitivity	Specificity	PPV	NPV	Accuracy
Margin	Poorly Defined	18	8	10	72.7	90.1	44.4	96.8	88.4
	Well Defined	94	3	91					
Calcification	Present	27	8	19	72.7	81.2	29.6	96.5	80.4
	Absent	85	3	82					
Peripheral halo	Present	101	9	92	81.8	8.9	8.9	81.8	16.1
	Absent	11	2	9					
Shape	Taller than wide	11	4	7	36.4	93.1	36.4	93.1	87.5
	Not	101	7	94					
Internal vascularity	Present	46	10	36	90.9	64.4	21.7	98.5	67.0
	Absent	66	1	65					
Internal content*	Cystic	5	0	5	90.9	9.9	9.9	90.9	17.9
	Predominantly Cystic	6	1	5					
	Predominantly Solid	101	10	91					
Echogenicity**	Marked Hypo	8	7	1	90.9	84.2	38.5	98.8	84.8
	Hypo	18	3	15					
	Iso	49	1	48					
	Hyper	37	0	37					

*sensitivity and other statistics were calculated as cystic versus solid; **sensitivity and other statistics were calculated as hypo versus hyper; PPV: positive predictive value; NPV: negative predictive value

Table 2: Sensitivity of ultrasound parameters when combined together

Number of parameters	Total	Malignant	Benign	Sensitivity	Specificity	PPV	NPV	Accuracy
2	65	0	65	100.0	0.0	9.8		9.8
3	13	0	13	100.0	64.4	23.4	100.0	67.9
4	17	2	15	100.0	77.2	32.4	100.0	79.5
5	9	3	6	81.8	92.1	52.9	97.9	91.1
6	8	6	2	54.5	98.0	75.0	95.2	93.8

PPV: positive predictive value; NPV: negative predictive value

Table 3: Sensitivity of margin, calcification, and echogenicity in the prediction of malignant thyroid nodule

MCE	Total	Malignant	Benign	Sensitivity	Specificity	PPV	NPV	Accuracy
Positive for any	40	11	29	100.0	71.3	27.5	100.0	74.1
Others	72	0	72					

PPV: positive predictive value; NPV: negative predictive value

Table 4: Distribution of patients according to age

Age	Male	Female	Total
11-20	1	5	6
21-30	2	13	15
31-40	8	43	51
41-50	7	24	31
51-60	2	6	8
61-70	0	1	1
Total	20	92	112

DISCUSSION

In the present study, it was shown that most parameters had high sensitivity and hence it disagrees with the finding of Moon *et al*. [12] who stated that most ultrasound features were of low sensitivity in a study carried out on 831 patients with thyroid nodules. In Moon *et al*. study, hypoechogenicity gives the best sensitivity (87.2%), and this is comparable to the sensitivity of this parameter in the current study (90.9%). Also, Moon *et al*. stated that the specificity of taller than wide shape, poor margins, significant hypoechogenicity, and the presence of calcifications possessed the highest rates of specificity for malignancy, ranging from 90.8% to 96.1%. Comparable results were obtained in the current study for the latter parameters in the range of 81.2% to 93.1%. In another study, which included a relatively large sample size (672 patients and 1141 nodules) was carried out by Popovic *et al*. and on the contrary to the findings of the present

study, they found low sensitivity for most ultrasound features in detecting malignancy [13]. In Popovich *et al*., it was found that microcalcifications and taller than wide shape parameters gave the best rates of specificity. Another large study was carried out by Salmaslioglu *et al*. on 550 patients with multinodular goiter and this study it was found that micro-calcifications predicted malignancy with an 89.3% sensitivity [14].

The current results have significant clinical implications. They support the idea that single US features on their own are not sufficient to provide strong evidence to confirm or rule out a diagnosis of malignancy. The utilization of a number of US features in combination to select thyroid nodules that are going to be biopsied is recommended by The American Thyroid Association [4]. Data concerning the possibility of each US characteristic to be accompanied by malignancy would help the ultimate decision to carry out FNA biopsy. The current data also suppose that more certain features are needed to perform surgery in patients with inconclusive cytology which is one of the main problems faced by surgeons in routine daily clinical practice [15, 16]. Some suggestions have been proposed by some authors to combine ultrasound findings with some clinical features and or risk factors to make a better selection of patients. For instance, Moon *et al*. considered an evaluation in which a malignant behavior was suspected when two risk factors are present in addition to the solid configuration as assessed by ultrasound. The accuracy of this combined method reached 96.2%, and the sensitivity and specificity were 87.7 and 97.8% respectively [17].

Similarly, in the present study, we also found that the combination of solid morphological pattern with the other two parameters, namely poor margin and calcification was associated with better accuracy, sensitivity, and specificity. In another case-control study, it was found that the nodular size greater than 2 cm, microcalcification, and solid composition were associated with the highest rate of malignant behavior [18]. Again these findings support our observation that solid configuration and micro-calcification are main predictors of malignancy in a thyroid nodule [19].

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