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Original Article

Diagnostic value of Elastography in thyroid nodules

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Abstract

Introduction: Palpable thyroid nodules are very common in the general population. Most of these nodules are benign and only about 5% of cases are malignant. Ultrasound elastography is a newly developed technique that uses ultrasound to provide an estimation of tissue stiffness. The aim of this study was to assess the diagnostic value of elastography in the evaluation of thyroid nodules supplementary to other ultrasonographic criteria.

Methods: In a descriptive cross-sectional study, thyroid nodules in 60 patients, who were candidates for fine needle aspiration biopsy (FNAB), were examined with conventional ultrasonography and elastography. The number and size of nodules, echogenicity, and presence of microcalcification, circumferential halo, and internal structure, margin of nodules, vascularity, and elasticity were determined. Pathologic evaluation of nodules was performed using FNAB. Imaging findings were compared with FNAB results.

Results: In the present study, 54 (90%) nodules were reported as soft and 6 (10%) as hard by ultrasound elastography. According to the results of FNAB, 9.5% were considered as non-benign nodules requiring surgery; all of these nodules were reported as soft in elastographic evaluation.

Conclusion: Routine elastography for all of the patients with thyroid nodule may not help the process of diagnosis. Further studies are recommended on its application in the management of thyroid nodules.

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Introduction

Palpable thyroid nodules are present in 4–7% of the population.[1-4] Most of these nodules are benign and only about 5% of cases are malignant.[5-7]

In patients who have thyroid nodule, fine needle aspiration biopsy (FNAB) is a useful tool for the diagnosis of thyroid cancer.[8] It should be noted that FNAB is an invasive procedure and, in addition to the possibility of errors in sampling and analysis, this method is not cost effective for studying of all nodules.[9,10]

Ultrasonography is the imaging study of choice for thyroid nodules. In addition to assessing the size and characteristics of the nodule, ultrasonography also provides guidance for diagnostic procedures such as FNAB. In comprehensive terms, ultrasound has a major role in studying thyroid nodules.[3]

Some sonographic features can be associated with increased risk of malignancy, including nodule hypoechogenicity, microcalcifications, central vascularity, irregular margins, an incomplete or absent

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halo, and an anteroposterior diameter greater than transverse diameter.[11,12]

Ultrasound elastography is a newly developed technique that uses ultrasound to provide an estimation of tissue stiffness by measuring the degree of distortion under the application of an external force.[13-15] There are several reports that this method can be helpful in distinguishing benign nodules from those that are malignant and in previous studies, the high stiffness of thyroid lesions has had correlation with malignancy.[16,17]

Elastography has already been used to differentiate cancers from benign lesions in prostate, breast, pancreas, and lymph nodes.[18-21] It has also been used for assessment of hepatic fibrosis.[22] The aim of this study was to assess the diagnostic value of elastography in the evaluation of thyroid nodules supplementary to other ultrasonographic criteria.

Methods

This was a descriptive cross-sectional study. From the patients referred to the endocrinology outpatient clinics of the Tabriz University of Medical Sciences, Iran, from April to December 2013 with a diagnosis of thyroid nodule, 60 patients who were candidate for FNAB enrolled in this study. The inclusion criteria were the presence of palpable thyroid nodule and having normal thyroid function tests. The study group consisted of 52 women (86.7%) and 8 men (13.3%). The mean age of the patients was 45.83 ± 11.11 years (range: 22–76 years).

The study plan was reviewed and approved by the university ethical committee, and an informed consent was obtained from every patient. The project was funded by the Bone Research Center, Tabriz University of Medical Sciences.

Initially, B-mode and color Doppler ultrasound were performed for all nodules, by an experienced sonographer and then elastographic examination using Medison v10 ultrasound machine equipped with a 7.5 MHz linear probe was done for the prominent nodules which were to undergo FNAB.

Conventional ultrasound images of thyroid nodules were obtained with patients positioned lying on their back with their neck slightly extended. The number and size of nodules, echogenicity, presence of microcalcification (tiny, punctuate echogenic foci of 1 mm or less), circumferential halo, internal structure, and margin of nodules were determined. Vascularity of each nodule was evaluated with color Doppler ultrasound.

The echogenicity of the nodules was described as hyperechoic, hypoechoic, and isoechoic in comparison to normal thyroid parenchyma. The nodules were categorized as solid, predominantly solid (< 50% cystic change), predominantly cystic (> 50% cystic change), and cystic based on their structure. The margins were classified as well-defined and poorly-defined. The shape was determined by measuring the anteroposterior diameter to transverse diameter ratio.

To perform elastography, the region of interest (ROI) was defined as a nodule with sufficient surrounding thyroid tissue. The technique used for the elastographic examination was the application of light compression with the ultrasound probe to the anterior neck.

As it is important to maintain a constant level of pressure throughout the examination and to reduce the intra-examiner variability, a standardized external compression was applied to the neck by using real time measurements displayed on an indicator-bar with a numerical scale (graded from 1 to 5) which gives a feedback on the compression quality.

In general, the nodules were classified into two groups according to the Ueno and Ito elasticity score; soft (elasticity in the whole or a large part of the nodule) and hard (elasticity only at the peripheral part of the nodule or no elasticity of the examined area).[23]

Due to 7 patients' unwillingness to undergo FNAB, a total of 53 FNABs were performed.

If there were more than one nodule, FNAB was performed on that nodule which was evaluated by elastography and had been identified by the sonographer.

FNAB was performed using a 23-gauge needle. Obtained specimens (6 to 10 slides), after fixation in alcohol, were sent for histopathologic examination.

To assess the interobserver agreement among pathologists in grading the quality of specimens, 10 specimens were analyzed by two different pathologists. Because of the excellent interobserver agreement between the two pathologists (kappa values > 0.7), one pathologist reported the rest of the specimens.

The Bethesda system was used for reporting thyroid cytopathology (Table 1).[24]

The sonographer, FNAB performer, and pathologist were not aware of the purposes of the study.

Statistical analysis was performed by SPSS for Windows (version 16; SPSS Inc., Chicago, IL, USA) using descriptive statistical methods.

Results

Among 60 patients, 29 (48.3%) patients had 1 thyroid nodule, 15 (25.0%) patients had 2, 6 (10.0%) patients had 3, and 10 (16.7%) patients had 4 or more than 4 thyroid nodules.

Sonographic findings of nodules are shown in table 2.

By ultrasound elastography, 54 (90%) nodules were reported as soft and 6 (10%) as hard. Results of pathologic evaluation are shown in table 1.

According to the results of FNAB,

Table 1. FNAB (fine needle aspiration biopsy) results, classified according to Bethesda system for reporting thyroid cytopathology

Bethesda category	Frequency (n)	Percent (%)
I (nondiagnostic or unsatisfactory)	6	11.3
II (benign)	41	77.4
III (atypia of undetermined significance or follicular lesion of undetermined significance)	1	1.9
IV (follicular neoplasm or suspicious of a follicular neoplasm)	2	3.8
V (suspicions of malignancy)	1	1.9
VI (malignant)	2	3.8
Total	53	100

Table 2. Sonographic findings of nodules

Sonographic feature		Frequency (n)	Percent (%)
Echogenicity	Hyperechoic	31	51.7
	Hypoechoic	20	33.3
	Isoechoic	9	15.0
Microcalcification	Present	11	18.3
	Absent	49	81.7
Margin	Sharp and well defined	48	80.0
	Irregular and poorly defined	12	20.0
Halo	Present	15	25.0
	Absent or incomplete	45	75.0
Texture (internal structure)	Solid	21	35.0
	Predominantly solid	35	58.3
	Predominantly cystic	3	5.0
	Cystic	1	1.7
Vascularity	Increased (central)	13	21.7
	Increased (peripheral)	36	60.0
	Decreased	10	16.7
	Normal	1	1.7
Shape	Taller than wide	7	11.7
	Not taller than wide	53	88.3

5 (9.5 %) of the 53 nodules were considered as non-benign nodules requiring surgery (Bethesda categories IV, V, and VI).

Sonographic features that imply an increased risk of malignancy in thyroid nodules, in 5 nodules which were considered as non-benign nodules requiring surgery, were as follows:

- 3 nodules were reported as hyperechoic, 1 as hypoechoic, and 1 isoechoic
- 4 nodules were without halo
- 2 nodules had a solid structure and 3 nodules were predominantly solid
- 3 nodules showed peripheral vascularity and 2 nodules had decreased vascularity
- Microcalcification was detected only in 1 nodule
- All 5 nodules had well-defined margins

It should be noted that all 5 of the above-mentioned nodules were reported as soft in elastographic evaluation.

Discussion

Thyroid nodules are relatively common and carry a low, but noticeable risk of malignancy.[1,4,5] The most important challenge is differentiating benign from malignant nodules, and precise diagnosis and management of malignant nodules in the early stages.

The value of ultrasonography in the evaluation of thyroid nodules has been investigated in several studies.[7,11,12]

In the latest guidelines released by the American Thyroid Association, if the thyroid function tests are normal, the next step in the work-up of thyroid nodule detected by palpation is ultrasonography.[25] Therefore, ultrasound is increasingly used for the evaluation of thyroid nodules.

It must be noted that the results of ultrasound are highly dependent on the instrument used and the operator. Specific sonographic criteria have been proposed to differentiate benign from malignant nodules.[3,6,7] However, ultrasonography is not accepted in any reference as the sole method for making a final decision in approach to thyroid nodule. Moreover, according to the American Thyroid Association recommendations, FNAB should ultimately be used as the procedure of choice for evaluating thyroid nodules.[25,26]

Efforts are employed to avoid unnecessary FNABs by defining more precise criteria differentiating malignant from benign thyroid nodules with noninvasive methods. In this regard, elastography has been introduced as a technique that evaluates the degree of distortion of a tissue under the application of an external force. Because softer parts of tissue deform more readily than the stiffer parts, this technique enables objective evaluation of tissue stiffness from the deformation rate.[27] Furthermore, as noted, its performance has already been shown in the differential diagnosis of breast and prostate carcinomas.[13,19]

Our study investigated the supplementary role of elastography in the differential diagnosis of thyroid nodules.

In the present study, 3.8% of thyroid nodules were malignant (Bethesda category VI) and 5.7% were suspicious for malignancy (Bethesda categories IV and V) based on the results of FNAB. This is in accordance with many studies.[24]

In a retrospective evaluation of 849 nodules that were diagnosed at surgery or biopsy in 831 patients, the presence of at least 1 malignant feature had a sensitivity and specificity of 83.0% and 74.0%, respectively.[28] In another study of 1244 nodules in 900 patients, of 233 nodules that were ultrasonographically evaluated as malignant, 76.8% were also evaluated as malignant by cytology FNAB.[26]

Elastographic findings in our study were not able to differentiate between benign and malignant nodules, but in other studies, including the study of Rago et al., elastography has shown great potential in the diagnosis of thyroid cancer, especially in nodules with indeterminate cytology.[7]

Asteria et al. have reported sensitivity of 94% and specificity of 81% for the differential diagnosis of thyroid nodules in elastographic evaluation of 86 nodules in 67 patients.[17] Kagoya et al., in a study performed on 47 thyroid nodules, have concluded that although elastography can assist in the differential diagnosis of thyroid nodules, its diagnostic performance is not ideal at present.[29]

The noticeable point in some past studies is previous bias in sample selection. For example, samples have been selected from patients who were referred for surgery, but in our study, attempts have been made to enroll patients without any previous selection from the beginning of study, only if there is a nodule requiring initial evaluation.

Based on the results of our study, routine elastography may not help the process of diagnosis for all of the patients with thyroid nodule. If elastography is performed in selected cases, such as indeterminate or suspicious FNABs, it would probably be able to yield more applicable results.

The present study has some limitations. In our study, results of ultrasonography has little predictive value in differentiating benign and malignant thyroid nodules which seems to be due to the small sample size of the study, electing subjects from the entire referred population without any preliminary selection, and as a result, the low number of malignant nodules.

Conclusion

Ultrasonography and elastography may not replace cytologic evaluation in the assessment of thyroid nodule, and FNAB cytology is considered the gold standard diagnostic test for the diagnosis of thyroid nodules. Despite the value of elastography in differentiating benign from malignant lesions in other tissues debated in previous studies, in this study, elastography was not able to differentiate benign from malignant thyroid nodules.

Due to the noninvasive nature of ultrasound and elastography and easiness of performing them, further studies should be designed and implemented for their application in the management of thyroid nodules, considering more samples without sample selection bias. Conducting more surveys on elastography of thyroid nodules in suspicious cases prior to surgery will probably yield more tangible results.

Conflict of Interests

Authors have no conflict of interest.

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