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ORIGINAL ARTICLE

Validity of Elastography in Differentiating Benign and Malignant Thyroid Nodules, Keeping Histopathology as Gold Standard

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ABSTRACT

Background: Elastography is a method recently being used in the evaluation of thyroid nodules by comparing tissue elasticity. The aim of this study was to determine the diagnostic accuracy of elastography in differentiation between benign and malignant thyroid nodules, taking histopathology as gold standard.

Methods: Total of 50 patients with palpable thyroid nodule of any size of age 20-60 years of either gender were included. elastography was performed in every patient by using a high resolution unit with a linear array probe centered at 7.5 MHz, elastography was performed in every patient by a consultant radiologist benign or malignant thyroid nodules was noted. Elastography findings were compared with histopathology report

Results: All the patients were subjected to strain ultrasound elastography. USG supported the diagnosis of malignant thyroid nodules in all 50 patients. Histopathology confirmed malignant thyroid nodules in 46 (true positive) cases where as 4 (false positive) had no malignant lesion on histopathology. In USG negative patients, 47 were true negative while 2 were false negative. Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of strain ultrasound elastography in differentiation between benign and malignant thyroid nodules, taking histopathology as gold standard is 90.0%, 90.30%, 92.31%, 94.77% and 93.18% respectively

Conclusion: According to this study, strain ultrasound elastography is the non-invasive modality of choice with high diagnostic accuracy in diagnosing malignant thyroid nodules.

Keywords: Thyroid cancer, Ultrasound elastography, Sensitivity, Specificity

INTRODUCTION

Thyroid nodules are reported to be found in 33% of unselected adults between the age of 18 and 65 years and in 50% of the population of over 65 years of age.1

Although the majority of the thyroid nodules are benign, malignancy has a prevalence of 5-15%. 2 After a thyroid nodule is found during a physical examination, a referral to an endocrinologist, or a thyroidologist may occur. Most commonly an ultrasound is performed to confirm the presence of a nodule, and assess the status of the whole gland. Measurement of thyroid stimulating hormone and anti-thyroid antibodies will help decide if there is a functional thyroid disease such as Hashimoto's thyroiditis present, a known cause of a benign nodular goiter. 2 Measurement of calcitonin is necessary to exclude the presence of medullary thyroid cancer. Finally, to achieve a definitive diagnosis before deciding on treatment, a fine needle aspiration cytology test is usually performed and reported according to the Bethesda system.2

Ultrasound (US) is accurate in the detection of thyroid nodules, but it has a relatively low diagnostic performance for the differentiation between benign and malignant nodules.3 US sensitivity and specificity in characterizing thyroid nodules vary considerably from study to study and range between 52 and 97% and 26.6 and 83%, respectively.3,4 According to the American thyroid association guidelines, no single US feature or combination of features is adequately sensitive or specific to identify all malignant nodules.5

Elastography is a method recently being used in the evaluation of thyroid nodules by comparing tissue elasticity.6 Strain and shear wave elastography (SWE) are two types of elastography still being used in clinical practice.7 two kinds of elasticity can be assessed by strain elastography. First, colors around and within the nodules are evaluated and visually scored according to the 4-5 scale scoring systems. Second, regions of interest are specified as the target region and the adjacent reference region. Later, elastography calculates strain ratio automatically. Higher strain ratio leads to a high probability of malignancy.8

In a study, the prevalence of malignant thyroid nodule was found to be 40.65% and sensitivity and specificity of strain ultrasound elastography as 88.0% and 93.0% respectively in differentiating benign and malignant thyroid nodules. 9 Another study has shown that strain elastography had the highest sensitivity of 100.0% and specificity of 80.2% in the differentiation between benign and malignant thyroid nodules.10

The available literature on diagnostic accuracy of strain ultrasound elastography in differentiation between benign and malignant thyroid nodules has shown variable results and also no local statistics available on this, so we did this study to determine the diagnostic accuracy of strain ultrasound elastography in differentiation between benign and malignant thyroid nodules. As biopsy is gold standard to determine the exact nature of thyroid nodules, however it is invasive and has risk of bleeding, so there is need for reliable, non-invasive technique that can accurately assess the nature of thyroid nodule.

The results of our study will provide our population with a non-invasive, cheap and easily available imaging modality for differentiating benign and malignant thyroid nodule and thus selection of timely and proper treatment option in order to reduce the morbidity and mortality of the disease as well as the purely invasive diagnostic biopsies

MATERIAL AND METHODS

This Cross sectional validation study was conducted in tertiary care Peshawar from 1st August 2019 to 31st July 2021. A total of 50 patients were consecutively selected. The inclusion criteria were patients with 20-60 years of age, patients with palpable thyroid nodule of any size (on clinical examination) and with duration of disease >3 months were included in the study. Patients with previous history of thyroid surgery and patients with already proven

histopathology (assessed on medical record) were excluded from the study.

After approval of the ethical committee of our hospital, patients fulfilling the inclusion criteria were randomly selected through the out patients Department. After taking informed consent, ultrasound elastography was performed on every patient by using a high-resolution unit with a linear array probe centered at 7.5 MHz. Strain ultrasound elastography was performed in every patient by a consultant radiologist benign or malignant thyroid nodules was noted as per-operational definition. Elastography findings were compared with histopathology report which was performed in the concerned ward and sent to the institutional pathology laboratory.

All this data (age, gender, duration of disease, size of nodule, benign and malignant thyroid nodule) was recorded on a specially designed proforma. The data was entered and analysed on SPSS 20. Mean and standard deviation were calculated for age, duration of disease and size of nodule. Frequency and percentage were presented for gender, benign and malignant thyroid nodule on strain USG and histopathology. 2×2 contingency table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy. Post stratification was used through Chi- square test keeping <0.05 level of significance to compare the difference between the two groups.

RESULTS

Age range in this study was from 30-70 years with mean age of 40±3.16 years. Mean duration of disease was 9.03±2.12 months. Mean size of nodule was 3.67±1.48 cm. All the patients were subjected to strain ultrasound elastography. USG supported the diagnosis of malignant thyroid nodules in all 50 patients. Histopathology confirmed malignant thyroid nodules in 46 (true positive) cases where as 4 (false positive) had no malignant lesion on histopathology. In USG negative patients, 47 were true negative while 2 were false negative (Table 1). Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of strain ultrasound elastography in differentiation between benign and malignant thyroid nodules, taking histopathology as gold standard is 90.0%, 90.30%, 92.31%, 94.77% and 93.18% respectively

Table 1: Diagnostic accuracy of ultrasound elastography in differentiation between benign and malignant thyroid nodules, taking histopathology as gold standard

	Positive result on histopathology	Negative result on histopathology
Positive on strain	46 (true positive)	4 (false positive)
Negative on strain	2 (false negative)	47 (true negative)

Table 2: Stratification of diagnostic accuracy with respect to duration of disease: <12 months (N=78) and >12 months (N=22)

Duration of disease <12 months		
Positive on strain ultrasonography	35 (true positive)	6 (false positive)
Negative on strain ultrasonography	4 (false negative)	34 (true negative)
Duration of disease >12 months		
Positive on strain ultrasonography	8 (true positive)	4 (false positive)
Negative on strain ultrasonography	2 (false negative)	9 (true negative)

Table 3: Stratification of diagnostic accuracy with respect to size of nodule <5 cm (N=68) and >5 cm (N=32).

	Positive result on histopathology	Negative result on histopathology	P value
Size of nodule <5 cm			
Positive on strain ultrasonography	31 (true positive)	3 (false positive)	0.001
Negative on strain ultrasonography	4 (false negative)	30 (true negative)	0.001
Size of nodule >5 cm			
Positive on strain ultrasonography	20 (true positive)	1 (false positive)	0.001
Negative on strain ultrasonography	2 (false negative)	10 (true negative)	0.001

DISCUSSION

Thyroid nodules are widely encountered in population, and they are usually benign. Its prevalence rates differ according to the population and the method used. It has also been reported that the prevalence of thyroid nodules is gradually increasing.11 the risk factors for thyroid nodules include female gender, advanced age, iodine deficiency, and previous head and neck radiation. The prevalence of thyroid nodules has been reported to be detected 2-6% by palpation, 19-35% by ultrasonography (US), and 8-65% in autopsy data.12 Although palpation has an important place in the diagnosis of thyroid nodules during physical examination, ultrasonography is the most accurate and cost effective method.12 Fine-needle aspiration biopsy (FNAB) is mandatory in the preoperative diagnosis of thyroid nodules and in distinguishing benign from malignant nodules. High-resolution thyroid ultrasonography and real-time elastography are adjuvant tools to be benefited from in order to decide whether the patient in question should undergo surgery, especially if the patient has indeterminate or nondiagnostic cytology.11 Elastography is a method recently being used in the evaluation of thyroid nodules by comparing tissue elasticity.13 Strain and shear-wave elastography (SWE) are two types of elastography still being used in clinical practice.14 Two kinds of elasticity can be assessed by strain elastography. First, colours around and within the nodules are evaluated and visually scored according to the 4-5 scale scoring systems. Second, regions of interest are specified as the target region and the adjacent reference region. Later, elastograph calculates strain ratio automatically. Higher strain ratio leads to a high probability of malignancy. A quantitative elastic value can be obtained by SWE depending on the acoustic pulse of an ultrasound probe, which stimulates tissues; accordingly, a real-time elastogram can be provided. The supersonic shear wave and acoustic radiation force impulse methods are used for the clinical assessment of thyroid nodules.14 In our study all the patients were subjected to strain ultrasound elastography. USG supported the diagnosis of malignant thyroid nodules in all 50 patients. Histopathology confirmed malignant thyroid nodules in 47 (true positive) cases where as 5 (false positive) had no malignant lesion on histopathology. In USG negative patients, 47 were true negative while 2 were false negative. Overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of strain ultrasound elastography in differentiation between benign and malignant thyroid nodules, taking histopathology as gold standard is 90.0%, 90.30%, 92.31%, 94.77% and 93.18% respectively . In a study, the prevalence of malignant thyroid nodule was found to be 40.65% and sensitivity and specificity of strain ultrasound elastography as 88.0% and 93.0% respectively in differentiating benign and malignant thyroid nodules. 9 Another study has shown that strain elastography had the highest sensitivity of 100.0% and specificity of 80.2% in the differentiation between benign and malignant thyroid nodules.10 in 2010 a meta-analysis of 8 studies including a total of 639 thyroid nodules resulted in encouraging results. An overall mean sensitivity of 92% (confidence interval 88- 96%) and mean specificity of 90%

(confidence interval 85-95%) were shown with a significant heterogeneity found for specificity in the different studies.15 However, the first encouraging results were challenged by a large retrospective study of Moon et al with 703 nodules (217 malignant).16 SE was assessed with both Asteria and Rago scoring criteria, but the results showed inferior performance of elastography; sensitivity 65.4% and negative predictive value (NPV) 79.1%, compared with gray-scale US features in combination (sensitivity 91.7% and NPV 94.7%), so the authors concluded that SE was not useful in recommending FNAB. Similarly, discouraging results are reported in another study of 2012 with 237 thyroid nodules (58 malignant) that reported lower performance of RTE in comparison with gray-scale US.17

CONCLUSION

This study concluded that ultrasound elastography is the noninvasive modality of choice with high diagnostic accuracy in diagnosing malignant thyroid nodules, and has not only dramatically improved our ability of diagnosing malignant thyroid nodules pre- operatively but also helps the surgeons for proper decision making. So, we recommend that strain ultrasound elastography should be done routinely in all thyroid lesions for accurate diagnosis of malignant thyroid nodules preoperatively and opting proper surgical approach.

REFERENCES

1 Niedziela M. Thyroid nodules. Best Pract Res Clin Endocrinol Metab. 2014; 28:245- 77.

2 Li N, Du XL, Reitzel LR, Xu L, Sturgis EM. Impact of enhanced detection on the increase in thyroid cancer incidence in the United States: review of incidence trends by socioeconomic status within the surveillance, epidemiology, and end results registry, 1980-2008. Thyroid. 2013; 23:103-10.

3 Cantisani V, Grazhdani H, Drakonaki E. Strain US elastography for the characterization of thyroid nodules: advantages and limitation. Int J Endocrinol 2015; 2015:1-8.

4 Kwak JY, Kim EK. Ultrasound elastography for thyroid nodules: recent advances. Ultrason. 2014; 33:75-82.

5 Azizi G, Keller J, Lewis M, Puett D, Rivenbark K, Malchoff C. Performance of elastography for the evaluation of thyroid nodules: a prospective study. Thyroid. 2013; 23:734-40.

6 Akcay MA, Semiz OA, Ahiskali R, Aribal E. The value of ultrasound elastography in differentiation of malignancy in thyroid nodules. Clin Imaging 2014; 38:100-3.

7 Andrioli M, Persani L. Elastographic techniques of thyroid gland: Current status. Endocrine. 2014; 46:455-61.

8 Ghajarzadeh M, Sodagari F, Shakiba M. Diagnostic accuracy of sonoelastography in detecting malignant thyroid nodules: a systematic review and metaanalysis. Am J Roentgenol. 2014; 202:379-89.

9 Yang J, Song Y, Wei W, Ruan L, Ai H. Comparison of the effectiveness of ultrasound elastography with that of conventional ultrasound for differential diagnosis of thyroid lesions with suspicious ultrasound features. Oncol Letters. 2017; 14:3515- 21.

10 Colakoglu B, Yildirim D, Alis D, Ucar G, Samanci C, Ustabasioglu FE, et al. Elastography in distinguishing benign from malignant thyroid nodules. J Clin Imaging Sci. 2016; 6:51.

11 Niedziela M. Thyroid nodules. Best Pract Res Clin Endocrinol Metab. 2014; 28:245-77.

12 Dean DS, Gharib H. Epidemiology of thyroid nodules. Best Pract Res Clin Endocrinol Metab. 2008; 22:901-11.

13 Monpeyssen H, Tramalloni J, Poirée S, Hélénon O, Correas JM. Elastography of the thyroid. Diagn Interv Imaging. 2013; 94:535-44.

14 Kwak JY, Kim EK. Ultrasound elastography for thyroid nodules: Recent advances. Ultrasonography. 2014; 33:75-82.

15 Bojunga J, Herrmann E, Meyer G, Weber S, Zeuzem S, Friedrich-Rust M. Real-time elastography for the differentiation of benign and malignant thyroid nodules: a meta-analysis. Thyroid. 2010; 20(10):1145-50.