



## ROLE OF USG ELASTOGRAPHY IN EVALUATION OF BENIGN AND MALIGNANT THYROID LESIONS WITH FNAC CORRELATION

### Radiology

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### ABSTRACT

**Introduction:** Ultrasound elastography is a newly developed non-invasive technique for evaluating thyroid nodules. This technique is very useful in differentiating malignant thyroid nodules from benign ones.

**Objective:** To evaluate the diagnostic accuracy of ultrasound elastography in differentiating benign from malignant thyroid nodules by using FNAC as a reference standard.

**Methodology:** 150 patients were selected for study, every patient underwent in conventional and then ultrasound elastography examination along with colour Doppler imaging. As FNAC was reference standard all patients underwent FNAC for the same.

**Results:** In our study, 43.3% (n=65) were males and 56.7% (n=85) were females. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy rate were 72.7%, 96.4%, 61.5%, 97.8% and 94.7% respectively.

**Conclusion:** Elastography has great potential as an adjunctive tool with other ultrasound modalities in diagnosing benign and malignant thyroid lesions.

### KEYWORDS

Thyroid nodules, benign, malignant, elastography

### INTRODUCTION

Thyroid nodular disease is characterized by the presence of one or more palpable or nonpalpable nodules within the parenchyma of the thyroid gland. A thyroid nodule is defined as a discrete lesion within the thyroid gland that is distinguishable from the adjacent normal parenchyma by ultrasonography.<sup>1</sup> Thyroid nodules occur with relatively high frequency in the general population with the prevalence of 4-7% by palpation alone and 13% to 67% (average 40%) by sonographic assessment. However, only less than 7% of thyroid nodules are malignant.<sup>2</sup> The risk factors for thyroid nodules include female gender, advanced age, iodine deficiency condition and previous head and neck irradiation. Nodular thyroid disease is the most common cause of thyroid enlargement. Most of the patients with thyroid disease present in clinic with midline neck swelling, occasionally causing dysphagia and hoarseness of voice. The thyroid diseases are classified into three categories: (i) Diffuse thyroid enlargement, (ii) Malignant tumours of the thyroid gland and (iii) Benign thyroid nodules.<sup>3</sup>

It is clinically important to diagnose malignant thyroid nodules from benign ones which do not require surgery and the challenge is to evaluate the thyroid nodule and to decide which patient should undergo cytology.<sup>4</sup> Conventional ultrasound does not provide direct information regarding the hardness of a nodule. Hence, elastography is a newly developed dynamic technique that uses ultrasound to provide an estimation of tissue stiffness by measuring the degree of distortion under the application of an external force. Ultrasound elastography is applied to study the hardness/elasticity of nodules to differentiate malignant from benign lesions.<sup>5</sup>

Strain and shear-wave elastography (SWE) are two types of elastography techniques still being used in clinical practice.<sup>6</sup> Two kinds of elasticity can be assessed by strain elastography. First, colors around and within the nodules of thyroid gland were 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.<sup>6</sup>

The aim of the present study was to evaluate both gray-scale US characteristics and strain elastographic findings in a large series of

thyroid nodules, which were also confirmed cytopathologically and the diagnostic accuracy rate of strain elastography was also tested in distinguishing benign from malignant thyroid nodules.

Ultrasound elastography is an easy and rapid imaging technique that is useful in differential diagnosis of thyroid tumor. Elastography use would reduce the rate of unnecessary thyroid biopsies because of its high elasticity value is being highly associated with benign nature. Hence if we find similar diagnostic accuracy as reported in other literature then in future ultrasound elastography can be used as a powerful adjunct tool with other ultrasound modalities for early detection of benign or malignant conditions and avoid unnecessary invasive work up and complication for patients.

### MATERIAL AND METHODS

Prospective study was conducted at Gujarat Cancer and Research Institute, Ahmedabad. We have an outpatient facility at our institute where patients come from all over India. All patients gave their full informed consent before examination and study is approved by institutional review board.

Between Jan 2017 to Jan 2018, 150 consecutive patients matching inclusion criteria (women 85 and 65 men; age range: 15-70 years) were included. The final diagnoses were based on histopathologic results.

### INCLUSION CRITERIA:

- Presence of a solid thyroid nodule on conventional ultrasonography.
- Plan to accept histopathological analysis.
- Absence of any previous local treatments (i.e. patients with hemithyroidectomy with solid nodule in remaining lobe.)

### EXCLUSION CRITERIA:

- Uncooperative and non-willing patients.
- Patients with cystic nodule (Total absence of solid component).
- Large solid nodule occupying >75% of thyroid lobe (not enabling adjacent normal thyroid gland component to be used as reference standard).
- Solid nodule with peripheral calcification (posterior acoustic shadow due to calcification limiting sensitivity).

**DATA COLLECTION PROCEDURE:**

Patients basic demographic (age, gender) and clinical history were taken. Elastographic evaluation of these patients was done with the help of the ACUSONS 3000S high end ultrasound machine. High frequency (9 to 12 MHz) linear array transducer is used. Both conventional gray-scale and elastographic scanning was done for the study.

Each patient first examined with B mode imaging to characterise thyroid nodule. (Size, its solid nature, presence of sufficient surrounding reference tissue and internal vascularity on Doppler) The region of interest (ROI) then selected (lesion with sufficient surrounding thyroid tissue).

All the patients were examined in supine position with hyperextended neck. Patients were instructed before examination to avoid swallowing and hold breath during examination to minimize motion of thyroid gland.

US Elastography was performed using both techniques, images of thyroid nodules were taken on both elastography and on conventional ultrasound. Outline of nodule is manually traced seeing gray scale images. Strain ration was then calculated.

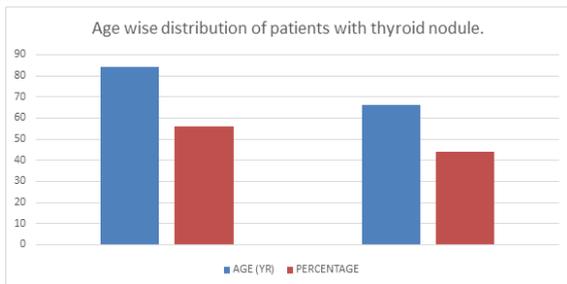
All patients underwent FNAC procedure, adequate sample was collected under USG guidance with all aseptic precaution and sent for histopathological analysis in pathology department at GCRI.

**RESULTS:**

A total 150 patients meeting inclusion criteria were evaluated to determine benign or malignant nature of thyroid nodule by using elastography technique with HPE taken as reference standard.

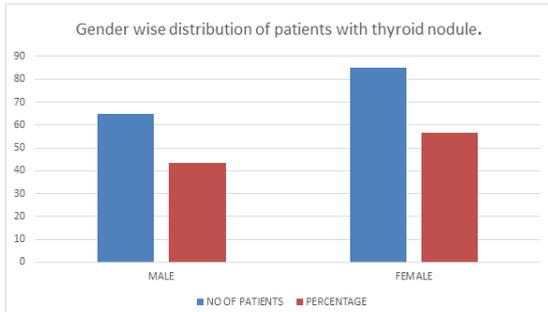
**Table-1. Age wise distribution of patients with thyroid nodule.**

AGE (YEARS)	NO. OF PATIENTS	PERCENTAGE (%)
15-45	84	56%
45-70	66	44%
TOTAL	150	100%



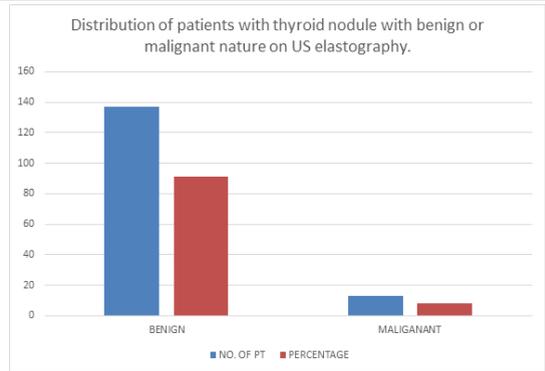
**Table-2. Gender wise distribution of patients with thyroid nodule.**

GENDER	NO OF PATIENTS	PERCENTAGE (%)
MALE	65	43.3%
FEMALE	85	56.7%
TOTAL	150	100%



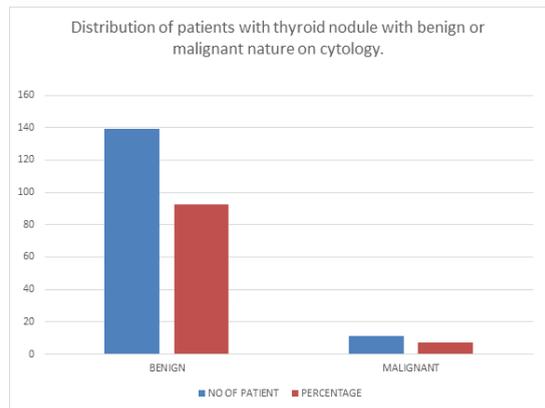
**Table-3. Distribution of patients with thyroid nodule with benign or malignant nature on US elastography.**

THYROID NODULES	NO. OF PATIENTS	PERCENTAGE (%)
BENIGN	137	91.3%
MALIGNANT	13	8.7%
TOTAL	150	100%



**Table-4. Distribution of patients with thyroid nodule with benign or malignant nature on cytology.**

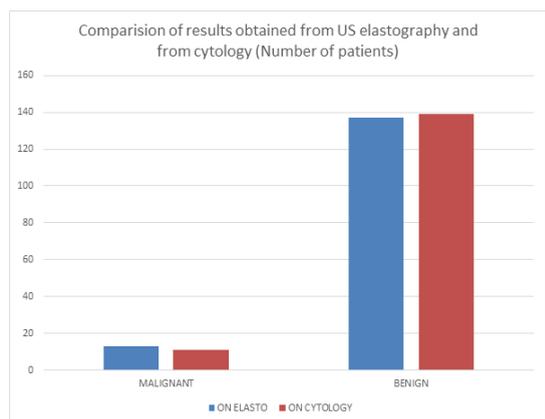
THYROID NODULES	NO. OF PATIENTS	PERCENTAGE (%)
BENIGN	139	92.7%
MALIGNANT	11	7.3%
TOTAL	150	100%



**Table-5 2x2 table demonstrating role of US elastography in differentiating benign from malignant nodule using cytology as a reference standard.**

ON ELASTOGRAPHY	ON CYTOLOGY	
	MALIGNANT (+VE)	BENIGN (-VE)
MALIGNANT (+VE)	a) TP (8)	b) FP (5)
BENIGN (-VE)	c) FN (3)	d) TN (134)
TOTAL	a+c (11)	b+d (139)

Sensitivity =  $a / (a + c) \times 100 = 72.7\%$   
 Specificity =  $d / (d + b) \times 100 = 96.4\%$   
 Positive predictive value =  $a / (a + b) \times 100 = 61.5\%$   
 Negative predictive value =  $d / (d + c) \times 100 = 97.8\%$   
 Accuracy rate =  $a + d / (a + d + b + c) \times 100 = 94.7\%$



**DISCUSSION**

Elastography technology increases the diagnostic efficiency of ultrasound and makes it possible to evaluate stiffness of thyroid nodule.

This study was planned to evaluate the role of US elastography in differentiating benign from malignant thyroid nodule.

In our study, By setting FNAC as reference standard shows that US elastography has sensitivity, specificity, PPV, NPV and accuracy rate of 72.7%, 96.4%, 61.5%, 97.8% and 94.7% respectively.

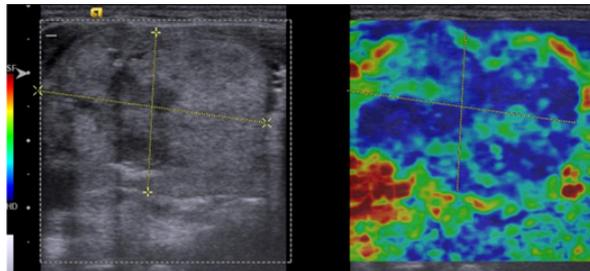
It is clinically very important to differentiate benign and malignant thyroid nodule and to plan further intervention such as biopsy. Elastography uses principle of degree of deformation of tissue according to its elasticity by external force and help to avoid unnecessary biopsy in patient with benign nodule which cannot be done with conventional US alone.<sup>7</sup>

Elasticity and hardness are significant physical parameters of tissues. All tissues are inherently viscoelastic and the hardness is related to their structural properties and the organizational micro and macro forms. Elastic changes are related to abnormal pathological conditions, the different organizational structures and the same structure of different pathological status make a distinct difference in elasticity and hardness.<sup>6-8</sup>

The thyroid nodules have benign and malignant lesions, which have different elasticity and hardness with different pathological patterns, ARFI can be used to measure the different viscoelasticity and hardness of the thyroid lesions by testing the velocity of tissues which reflects the different pathological types.

These are some US elastography images representing our study group.

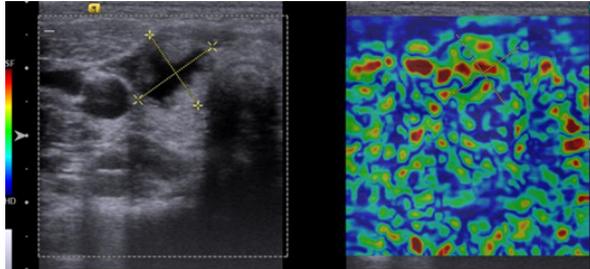
#### Case-1



**Case-1:** Shows hypoechoic lesion on grey scale image which appears to be hard (blue-solid areas) on strain method of elastography.

**On cytology correlation,** above mentioned lesion turn out to be malignant thyroid nodule.

#### Case-2



**Case-2:** Shows well defined hypoechoic lesion on grey scale image which appears to be soft (green areas) on strain method of elastography.

**On cytology correlation,** above mentioned lesion turn out to be benign thyroid lesion.

#### CONCLUSION

In conclusion, ultrasound elastography along with other ultrasound modalities is used as an adjunctive procedure to differentiate benign nodules from malignant ones hence avoiding unnecessary invasive procedure in patient with benign nodule.

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