Original Articles

"Role Of Elastography In Thyroid Nodules And It's Histopathological Correlation ."

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ABSTRACT

Aims & Objective: To determine the ultrasound elastography findings in thyroid nodules. To evaluate the diagnostic accuracy of elastography of thyroid nodules in differentiatingbenign and malignant nodules. To correlate the ultrasound elastography with the FNA and/or histopathology findings.**Methods:** A prospective study of 50 patients presenting with thyroid swelling was carried out by grey scale & Color Doppler ultrasound with ultrasound elastography and findings were correlated with histo-pathological results. **Result:** In our prospective observational study of 50 patients with thyroid nodulesincidence of thyroid nodules is more common in the young and middle aged patients(15-40 years).All the pathologies are much more common in females than in males (male:female ratio=1:9)The benign pathologies(78%) are observed much more often than the malignantones(22%).Various B-mode ultrasound characteristics of thyroid nodules like irregular margins,microcalcifications, absence of halo, increased intralesional vascularity and hypoechogenicity, help to characterize the thyroid nodules and are indicative of being suspicious of malignancy. **Conclusion:** The combined use of thyroid US elastography with B-mode US may improve the ability to discriminate benign from malignant thyroid nodules and reduce the number of needed FNAs.

INTRODUCTION

The thyroid gland is one of the largest endocrine glands. The thyroid gland is found in the neck, below the thyroid cartilage. Because of the superficial location of the thyroid gland, high resolution real-time grey-scale and Color Doppler sonography can demonstrate normal anatomy and pathologic conditions with remarkable clarity.

Thyroid nodules are a common entity found in about 4-8% of adults by palpation, 41% by ultrasound and 50% at autopsy according to studies done. A minority of these, less than 5% are malignant[1,2]. Thyroid nodules are commonly seen in areas of iodine deficiency, females with increasing age and after radiation exposure. A thyroid nodule is an abnormal growth of cells within the thyroid gland and can be non-cancerous (benign) or cancerous (malignant). The clinical importance of thyroid nodule management rests with the need to detect malignant nodules that occurs in 5%-10% among asymptomatic nodules depending on age, gender, radiation exposure history, family history and other factors (Mazzaferri 1993; Frates et al. 2005; Yeung and Serpell 2008). These well differentiated thyroid malignancies have excellent prognosis with 80 - 95% having 10 year survival rate. Early detection and treatment of thyroid nodules are necessary in order to manage thyroid malignancies[3].

Among the diagnostic methods, ultrasonography (USG) is the most fundamental one. With the application of high-resolution USG devices, the assessment, with high-frequency linear probes, has become very important in thyroid gland diseases. Ultrasonic waves, which penetrate easily into the thyroid gland, can easily monitor the modifications in the gland. The fact that USG is cheap, common and easy to use makes it very important in characterization of nodules and diagnostic in case of thyroid diseases [4,5].

USG is first line investigation for detection of thyroid nodules and further characterizing them as it is an excellent, noninvasive, and cost-effective diagnostic tool[6]. Several sonographic patterns of malignant thyroid nodules described include: hypo echogenicity, blurred or speculated margins, spot micro-calcifications, absent halo sign and intra-nodular vascularity (type 2 vascularity). These patterns have a low sensitivity and specificity hence rendering the examination inaccurate in differentiating benign and malignant thyroid nodules [7,8,9].

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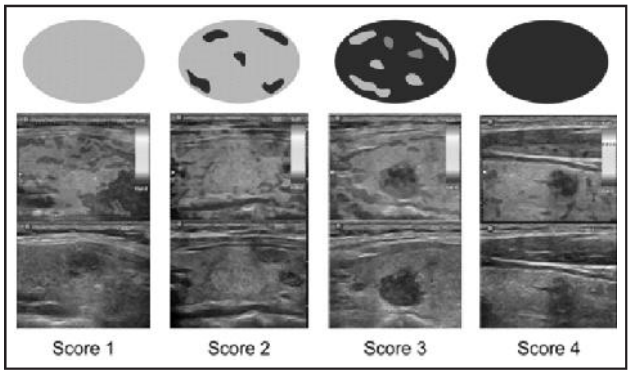
According to the American Thyroid Association(ATA) guidelines, no single US feature or combination of features is adequately sensitive or specific to identify all malignant nodules [10].

For this reason, fine needle aspiration biopsy (FNAB) is required for the nodules greater than 10mm or those with suspicious ultrasound signs[10,11,12,13,14]. Fine needle aspiration cytology or biopsy is mainstay of procedure to differentiate benign thyroid nodule from malignant. This can prevent further morbidity and mortality of the patients due to early diagnosis and appropriate further management[15]. However, FNA has inherent limitations, with only moderate sensitivity and specificity in various studies[14,16,17,18] due to indeterminate and nondiagnostic results. As a consequence, a significant number of patients eventually receive unnecessary thyroid surgery.

Strain Elastography is the most common and most widely used UE method. Strain imaging was the first introduced USE technique[31]. In this method, external compression is applied with the ultrasound probe on the area or is generated by internal physiologic motion (e.g. cardiovascular, respiratory). Manual compression works fairly well for superficial organs such as the breast and thyroid while internal physiologic compression may be used for assessing elasticity in deeper located organs such as the liver[16].

Below mention figure shows Asteria's criteria defined a score of 1 as elasticity that is entirely soft in the nodule, 2 as mostly soft in the nodule, 3 as mostly hard in the nodule, and 4 as entirely hard in the nodule[21].



MATERIALS AND METHODS:

Inclusion criteria:

- Patients with physical examination suggestive of palpable thyroid swelling in lower neck in midline or on either side.
- Patients with signs and symptoms suggestive of thyroid disorder (Hyper/ Hypothyroidism) and/or patients with altered thyroid function tests

Exclusion criteria:

- Patient already diagnosed and treated for thyroid lesion
- Purely cystic nodules
- FNAC showing inadequate aspirated material or no final cytology or histopathologicaldiagnosis.

Study period

- January 2019- October 2019 (10 months).

Study population

- 50 women.

Methodology:

TECHNIQUE OF THYROID SONOGRAPHY

The patient is examined in a supine position, with the neck slightly overextended by a pillow under the shoulders. High frequency linear array transducer is used (at least 7.5 MHz). Color doppler evaluation is recommended for a better diagnosis.

The ultrasound examination of thyroid should always include the entire neck, looking for abnormal lymph nodes, enlarged parathyroid glands and abnormal masses. Both lobes must be scanned individually in transverse and longitudinal planes. Other structures in the neck such as common carotid arteries and internal jugular veins, the strap muscles, cervical supraclavicular lymph nodes are also evaluated and the findings are documented. This is followed by Doppler evaluation of thyroid gland and of any lesion found.

TECHNIQUE OF ULTRASOUND ELASTOGRAPHY

Ultrasound elastography was performed during the conventional ultrasound examination of the thyroid gland. The linear probe was placed on the neck with light pressure and a transverse plane with maximum diameter of the nodule was obtained. An additional plane with different characteristics, such as echogenicity and presence of calcification, was also selected for the evaluation of elasticity. A highlighted box shows the nodule under examination in the centre and some amount of normal thyroid tissue around the nodule. The patient is then asked to hold his or her breath for four to five seconds while the USE data were acquired. Adequate compression is shown by a green color on all the compression bars at the side of the image. An elastogram is then displayed over the conventional ultrasound image in a color scale. E-ThyroidTM, a quantitative scoring method, is used to calculate elasticity contrast index (ECI). The ECI value is computed interactively and displayed on the monitor of the US machine after the

nodule's boundaries are delineated by the operator. A larger ECI value suggests a stiffer nodule, indicating an increased likelihood of malignancy. The largest among multiple ECI values is selected for analysis of diagnostic accuracy[19].

Statistical analysis

- All data was analyzed using the Microsoft Excel software. Statistical analysis of data was done after compiling and tabulation of data.

RESULTS

- Fifty women with thyroid lesions were assessed in the study. On sonography out of 50 lesions 13 were benign thyroid nodule, 17 were goiter, 8 were colloid nodule, 4 were follicular neoplasm and 8 were malignant lesions of thyroid. (Table I)
- Elastography color score shows Out of 50 lesions 20 shows score 1; 13 shows score 2; 12 shows score 3 and 5 shows score 4. (Table II)
- Elastography contrast index shows out of 50 lesions 38 shows ECI value less than 3 and 12 shows ECI value more than 3.ECI value of <3 was found in majority(76%) of cases, suggesting a benign etiology. (Table III)
- Fifty lesions were assessed by FNA/ histopathological examination; out of 50 lesions 2 were adenomatous nodule; 4 were colloid nodule; 28were colloid nodule with cystic changes; 2 were thyroiditis; 3 were follicular adenoma; 7 were papillary carcinoma and 4 were follicular carcinoma. (Table IV)
- Thyroid nodules' elastography color scores of 1 and 2 brought 33 cases of true negative (benign) cases on FNA/histopathology test. Elastography scores 3 and 4 revealed 11 cases of true positive (malignant) nodules on FNA/histopathology. The false positive cases were 6 and there were no false negative cases.Thus, the sensitivity and specificity of elastography color scoring were 100% and 84.6% respectively. The elastography color scoring had a positive predictive value (PPV) and negative predictive value (NPV) of 68.75% and 100% respectively. The diagnostic accuracy was 88% (Table V).
- Correlation of ECI value to FNA / Histopathology findings showed that ECI value of less than 3 produced 37 true negative (benign) results on FNA/ histopathology. ECI value of 3 or more produced 10 true positive (malignant) cases on FNA/ histopathology. The sensitivity, specificity, positive and negative predictive values(PPV and NPV) of ECI value were 90.9%, 94.9%, 83.3% and 97.36% respectively. The diagnostic accuracy was 94% (Table VI).

DISCUSSION

Various B-mode characteristics of the thyroid nodules were examined before elastography. This demonstrated that no single sonographic feature can confidently distinguish benign and malignant thyroid nodules. This is in agreement with previous studies done by Frates MC et al in 2005, Papini et al (2002) and Jason D. Iannuccil et al (2004) where they evaluated the various sonographic characteristics in differentiating benign and malignant thyroid nodules.

In our prospective observational study of 50 patients with thyroid nodules we draw conclusionsMajority of the patients present with nodular swelling of thyroid. The benign pathologies(78%) are observed much more often than the malignantones(22%).The most common benign pathology is colloid goiter (56%) while amongst the malignantpathologies, papillary carcinoma(14%) is the most common.

Moreover, no single ultrasound feature is pathognomic for malignancy.

The elastography color scoring has good sensitivity, specificity and negative predictive value (100%, 84.6% and 100% respectively), while it has a low positive predictive value(PPV) of 68.75%. The sensitivity, specificity, PPV and NPV of ECI value with cut-off for malignancy >3are quite good.

High resolution grey scale ultrasound has emerged as an initial imaging modality ofchoice for the evaluation of patients with thyroid enlargement. Although FNA is considered the gold standard for diagnosis, it is yet imperfect as up to 15-30% of samples are considered non-diagnostic or indeterminate

Thyroid ultrasound elastography is a noninvasive method of assessing thyroid nodules that provides complementary information to B-mode US and FNA. Like other USG methods, it is easy to access, performed in real time, non-invasive, easy to apply, it takes short time and does not contain ionizing radiation.

The combined use of thyroid USE with B-mode US may improve the ability to discriminate benign from malignant thyroid nodules and reduce the number of needed FNAs. Thyroid USE may also aid with the difficult problem of distinguishing between malignant and benign follicular neoplasms.

Ultrasound elastography using color scoring and ECI values is valuable; Because of its high specificity in predicting malignancy, ultrasound elastography can be a good adjunctive diagnostic tool to conventional

ultrasound in screening of nodular thyroid disease and in determining which nodules should be biopsied or excised elastography. On the contrary, USE is not sensitive enough to determine which nodules can only be followed with imaging without fine-needle aspiration cytology.

Thus, histo-pathological diagnosis by Fine-needle aspiration cytology or biopsy remains the most accurate method of differentiating benign from malignant nodules.

Table 1: Sonographic diagnosis of thyroid lesions

Radiological Diagnosis	No. of Patients	Percentage
Benign thyroid lesion / nodule	13	26
Goitre	17	34
Colloid nodule	08	16
Follicular neoplasm	04	08
Thyroiditis	00	00
Malignant lesion of thyroid	08	16
Total	**50**	**100**

Table 2: Elastography color score

Color Score	No. of Patients	Percentage
Score 1	20	40
Score 2	13	26
Score 3	12	24
Score 4	05	10
Total	**50**	**100**

Table 3: ECI value of Thyroid Nodules

ECI value	Frequency	Percentage
Less than 3	38	76
Greater than or equal to 3	12	24
Total	50	**100**

Table 4: Histopathology (FNAC/FNAB) results

Benign	No. of nodules	Percentage
Adenomatous nodule	02	04
Colloid nodule	04	08
Nodular colloid goitre/Colloid goitre with cystic changes	28	56
Thyroiditis	02	04
Follicular adenoma	03	06
Malignant		
Papillary carcinoma	07	14
Follicular carcinoma	04	08
Medullary carcinoma	00	00
Anaplastic carcinoma	00	00
Metastasis	00	00
Total	**50**	**100**

Table 5: Correlation between Elastography color scoring and FNA/histopathological diagnosis

ECI value	FNA/Histopathological diagnosis
	Benign
Less than 3	37 (94.9%)
False positives	2 (5.1%)
	Malignant
Equal to or more than 3	10 (90.9%)
False negatives	1 (9.1%)

Table 6: Correlation between ECI value and FNA/histo-pathological diagnosi

ECI value	FNA/Histopathological diagnosis
	Benign
Less than 3	37 (94.9%)
False positives	2 (5.1%)
	Malignant
Equal to or more than 3	10 (90.9%)
False negatives	1 (9.1%)

Image 1: COLLOID NODULE - ELASTOGRAPHY SUGGESTING BENIGN LESION

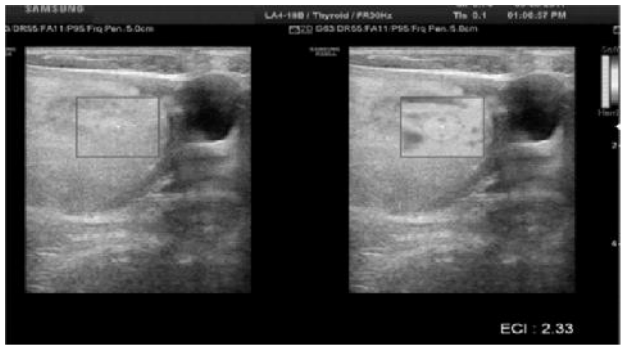


Image 2: COLLOID GOITRE – SOME OF THE SONOGRAPHIC FEATURES WERE SUSPICIOUS OF MALIGNANCY AND ELASTOGRAPHY SUGGESTED A BENIGN LESION

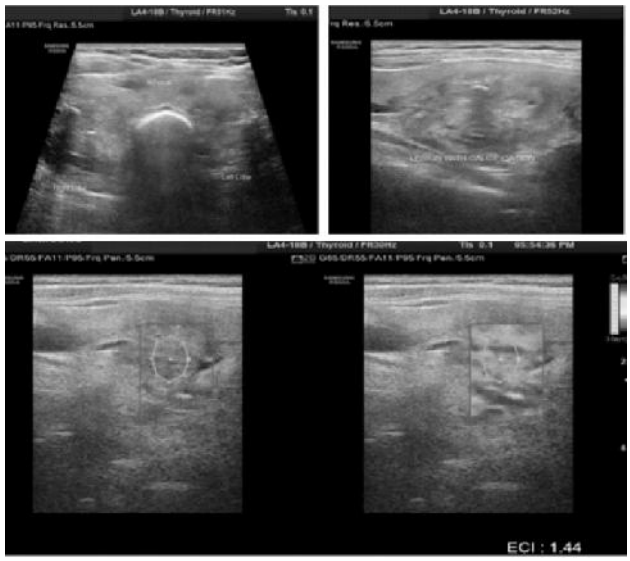


Image 3: FOLLICULAR ADENOMA – ELASTOGRAPHY SUGGESTING A BENIGN LESION

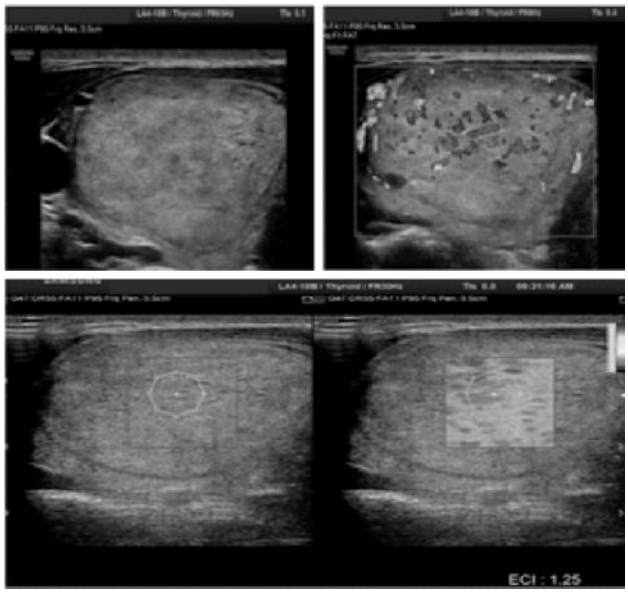


Image 4: FOLLICULAR CARCINOMA – ELSTOGRAPHY SUGGESTING A MALIGNANT LESION

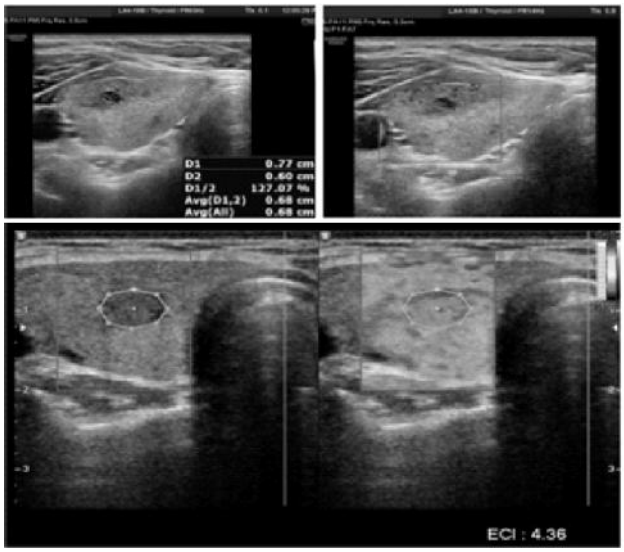
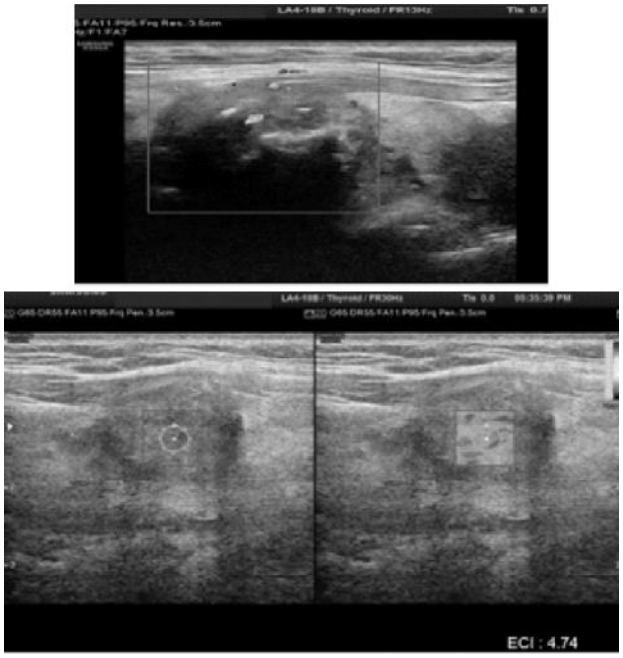


Image 5: PAPILLARY CARCINOMA – ELASTOGRAPHY SUGGESTING A MALIGNANT LESION



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