Section: Radiodiagnosis

Original Research Article

EFFICACY OF SONO ELASTOGRAPHY - TIRADS COMBINATION IN ASSESSMENT OF THYROID NODULES

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ABSTRACT

Background: Nodular thyroid disease is a common finding in the general population, specifically in iodine deficiency areas. While the majority of thyroid nodules are benign, the identification of malignant nodules using ultrasonography (US) is of great importance. When comparing other diagnostic modalities to US, they have shown to be less sensitive in differentiating between benign and malignant nodules. **Materials and Methods:** Ultrasound elastography is a non-invasive diagnostic modality that assesses the hardness of a lesion by measuring the quantity of distortion that occurs when that lesion is subjected to external pressure. It is assumed that malignant nodules are more likely harder than benign lesions. The aim of our study is to evaluate the diagnostic performance of Sono-elastography alone and its combination with (Thyroid Imaging Reporting and Data System) TIRADS for the assessment of thyroid nodules. **Result:** Out of 65 patients with thyroid nodules who satisfied the inclusion and exclusion criteria, 16 cases (24.6%) were malignant and 49 (75.4%) were benign nodules. Thyroid nodules with lower strain ratio values showed a higher likelihood of being benign while those with higher scores showed a higher probability for malignancy. The cut off strain ratio obtained to differentiate benign and malignant nodules was 2.55, with sensitivity and specificity of 75%, 91.8%, respectively. Sonoelastography combined with TIRADS also showed a positive outcome with diagnostic accuracy of nodules TIRADS IV & above being 86.1%. **Conclusion:** Sonoelastography can be a reliable screening tool for characterizing thyroid nodules and thus reduce the need for invasive Fine Needle Aspiration Cytology (FNAC).

INTRODUCTION

Thyroid nodules are a common finding in the general population. While most of these nodules are benign, the identification of malignant nodules is of vital importance.

The most sensitive non-invasive diagnostic modality for detection of thyroid nodules is high resolution ultrasonography.[1] Despite this there is no sonographic criteria that is completely reliable in distinguishing benign from malignant nodules.

Soft tissue structures tend to be more compressible than harder ones and a firm lesion is often associated with a higher risk of malignancy.

Based on this principle ultrasound elastography is used to evaluate the elasticity or hardness of identified nodules and help differentiating benign from malignant nodules.

This study aims to demonstrate the diagnostic accuracy of ultrasonography and real-time elastography in differentiating benign from malignant thyroid nodules and comparing it with histopathology diagnosis.

The objectives of this study include assessing the validity of the combination of TI-RADS grading with Sonoelastography as well as the diagnostic accuracy of Sonoelastography alone in differentiating benign from malignant nodules and comparing it with histopathology diagnosis.

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MATERIALS AND METHODS

Subjects: 65 patients with a clinically suspicious thyroid swelling were included in this study based on the inclusion and exclusion criteria. The inclusion criteria was patients with thyroid swellings who were undergoing FNAC/biopsy done for thyroid nodules. Already diagnosed cases of benign or malignant thyroid nodules were excluded to avoid selection bias.

Ultrasonography: The patients were made to lie in supine position and the probe was placed on the thyroid gland. Thyroid nodules were assessed for their characters and categorized using GE Voluson E6 ultrasound machine with high frequency linear probes (5-14 MHz), colour Doppler and Sonoelastography.

The probe was held perpendicular to the skin with application of a steady compression towards the nodule under examination. Colour coded bar confirmed the appropriate amount of displacement to generate the elastogram. When the appropriate amount of displacement was applied, the colour bar would display the maximum value (green). If the displacement was either too great or too small the color bar showed a lower value (red). Appropriate field of view (FOV) was selected which included the thyroid nodule under examination and the adjacent surrounding normal thyroid tissue as reference for the Strain ratio. The nodule under examination and the homogenous normal thyroid tissue used as a reference, were evaluated at the same depth. Finally strain ratio was calculated by selecting a reference region of interest

(ROI) over the normal thyroid tissue and then drawing a target ROI which included the nodule under examination. A minimum of three values were obtained and the median was selected for the final report. Patients then underwent USG guided FNAC/biopsy and the subsequent histopathological examination (HPE) reports were correlated with USG and elastography findings.

RESULTS

Demography and histologic results: Out of the 65 patients selected for the study between October 2018 and August 2020, HPE revealed 16 malignant nodules (24.6%) and 49 benign nodules (75.4%). Out of the 16 malignant cases, eight were papillary carcinomas, six were follicular carcinomas, one was medullary Carcinoma, and one was Hurthle cell carcinoma.

Five cases among the 16 malignant nodules (31%) were found in patients less than 40 years of age and the rest of the cases were seen in patients above 40 years (69%). The youngest patient who had a malignant nodule was a 20 year old woman, which was a case of papillary carcinoma of thyroid.

Out of 65 cases a majority were females (56), and only 9 of them were male. Only 3 out of 16 malignant thyroid nodule cases were seen in male population (two cases of papillary carcinoma of thyroid and one case of follicular neoplasm)

TIRADS and Strain elastography: Out of 65 cases, 13 had scoring of TIRADS II, 100% of which turned out to be benign.

Twenty-three scored TIRADS III, out of which 20 (90%) were benign and 3 cases (10%) proved to be malignant. Twenty-one cases scored TIRADS IV, out of which 16 (74.8%) were benign and 5 (24.8%) were malignant.

The eight TIRADS V cases were all malignant (100%). Thus we can establish the fact that there is an increasing risk for malignancy with increasing TIRADS categories.

The mean strain ratio of histopathology confirmed benign lesions were 1.89 (maximum strain ratio of 4.2 & minimum strain ratio of 1.1 and standard deviation of 0.59). The benign nodule with highest strain ratio of 4.2 was a case of colloid goitre.

The mean strain ratio of histopathology confirmed malignant lesions was 2.98 (maximum strain ratio of 5.1 & minimum strain ratio of 1.8 and standard deviation of 0.86). The malignant nodule with lowest strain ratio of 1.8 was a case of follicular neoplasm.

P value was <0.0001, significant.

Combination of TIRADS and strain ratio

32 out of the 49 benign cases had TIRADS <III and strain ratio of <2.55.

3 out of the 16 malignant nodules with TIRADS grading of <III and strain ratio of <2.55 were cases of follicular thyroid neoplasm (Follicular neoplasms are generally softer nodules in comparison with other thyroid malignancies)

Table 1: Association of HPE Findings with TIRADS and strain ratio findings

		HPE			
		Malignant		Benign	
		Count	Row N %	Count	Row N %
Any one	Either TIRADS >IV or Strain Ratio >2.55	13	43.30%	17	56.70%
	TIRADS <III and S Ratio <2.55	3	8.60%	32	91.40%
Both	Both Strain Ratio >2.55 and TIRADS >IV	11	73.30%	4	26.70%
	Others	5	10.00%	45	90.00%

Thirteen of the 16 malignant cases had either TIRADS>IV or strain ratio of >2.55. Only 4 out of the 49 benign cases had both strain ratio of >2.55 and TIRADS >IV. Three cases of Colloid nodular goitre and one case of toxic nodular goitre had strain ratio of >2.55 and TIRADS grading >IV. Eleven out of the 16 malignant cases had both strain ratio of >2.55 and TIRADS>IV.

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The sensitivity, specificity positive predictive value, negative predictive value and diagnostic accuracy of any one of either TIRADS >IV/ strain ratio of >2.55 or TIRADS <III & strain ratio of <2.55 were 81.2%, 65.3%, 43%, 91.4% and 70% respectively. The sensitivity, specificity positive predictive value, negative predictive value and diagnostic accuracy for both of TIRADS > IV and strain ratio of >2.55 were 68.7%, 91.8%, 73.3%, 90% and 86.1% respectively.

DISCUSSION

With the introduction of ultrasound, the incidence of thyroid nodules has increased due to the increase in identification of such nodules. Numerous recommendations for the risk stratification of thyroid nodules and their management are available in literature. Most often, confirmation of the suspicious character of the nodule requires a cytological examination of the material using a fine needle aspiration cytology (FNAC) which is the preferred first line confirmatory investigation. Currently, US, in combination with FNAB are the principle diagnostic tools for the diagnosis of thyroid nodule.

Presently the basic US technique used to assess thyroid nodules is gray-scale imaging (B-mode). An important step in the standardization of the assessment of the malignancy risk in thyroid nodules based on the US examination was the introduction of the TIRADS (Thyroid Imaging Reporting and Data System). This study was undertaken to evaluate and compare the findings of thyroid nodules on Ultrasonography and Elastography with histopathological correlation and to assess if Sonoelastography can be integrated into the TIRADS Lexicon. This study also incorporated sonoelastography, to evaluate its potential as an independent tool in assessment of thyroid nodules.

Several studies showed promising results for the use of sonoelastography (combined or not-combined with conventional US. Dobruch-Sobczak KS, Krauze A et al in 2019 conducted a prospective study in 208 patients with thyroid lesions employing B-mode ultrasound and sonoelastography (SE). Results revealed that ill-defined margins, marked hypoechogenicity, microcalcifications, thyroid capsule infiltrations, macrocalcifications and hard lesion in SE were associated with a higher Odds Ratio for malignancy. Multivariate analysis revealed that combining two features increased the Odds Ratio and the best combination was irregular margins and increased hardness on strain elastography.[2]

Yan J et al conducted a study in 2016 to compare the effectiveness of US-E with that of conventional grey scale US for differential diagnosis of thyroid lesions with suspicious US features. Study was performed in 150 thyroid nodules. Among which 86% of benign nodules showed strain ratio of 2.3+/- 1.01. Whereas majority of the malignant nodules had strain ratio (SR) of 6.39+/- 2.5, which was significantly higher. The conclusion was that SR is a useful tool differentiating benign from malignant thyroid nodules.[3]

Wang H et al 31 in 2012, conducted a study to find out accuracy of US-E in determining the nature of thyroid nodules and finding out clinical value of elasticity score and SR in differentiating thyroid nodules. The study was conducted on 131 solid thyroid nodules. A four-degree elasticity scoring system was followed for their evaluation, ES for soft was 1 & 2 and for hard was 3 & 4. SR was calculated using inbuilt software. Elasticity score had sensitivity and specificity of 78% & 80% for thyroid malignancies. SR >/=2.9 was used as cut off with sensitivity and specificity of 87% and 92%. The strain ratio of benign lesions were 1.64+/- 1.37, which was significantly different from that of malignant lesion (4.96+/- 2.13). Thus the, study showed that US-E is a useful index in differentiating thyroid nodules.[4]

Demography: This study included 65 patients with their ages ranging from 21 to 76 years with 56 females and 9 males. Based on the histopathological/ FNAC findings, it was found that 16 cases turned out to be malignant and 49 cases benign. Five cases among the 16 malignant nodules (31%) were found in patients below the age group of 40 years and the rest of the cases were seen in patients above 40 years (69%). Out of 65 cases, 56 were females, in which 43 cases were benign. Among the 9 male patients, 6 were benign and 3 were malignant. Hence majority of thyroid nodules were prevalent in females and most of the nodules were benign irrespective of sex. Brander A et al conducted study on 253 subjects in which majority of the cases were women and prevalence of abnormalities increased with age, and women showed more lesions than did men in in same age group.

Strain elastography: The calculation of strain ratio was done between nodule and surrounding normal thyroid parenchyma at the same depth. In the present study, strain value of >2.55 was considered as malignant based on analysis done. According to this 16 cases were deemed as malignant. Of which 13 were only actually proven as malignant on histopathology. Out of the 48 cases deemed as benign according to strain ratio, 44 cases turned out to be benign and 3 cases were malignant on histopathology.

According to Chong Y et al, Ultrasound elastography is a very helpful modality in prediction of thyroid malignancy. In his study the best cut off value used for prediction of malignancy was 3.1.

TIRADS with elastography: The sensitivity and specificity of TIRADS was found to be superior to Strain ratio and combining TIRADS with strain ratio did not improve the sensitivity and diagnostic accuracy.

However when we used sonoelastography as an independent diagnostic tool, then it showed increased sensitivity (75%) and specificity(91.8%).

This finding was similar to a study conducted by Schenke S et al in March 2018, to evaluate the

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diagnostic performance of elastography alone and combined with Thyroid Imaging Reporting And Data System (TIRADS) for the assessment of non autonomous thyroid nodules. They concluded that the sensitivity, specificity, positive predictive value and negative predictive value of TIRADS were superior to Sonoelastography and the combination of TIRADS and RTE in their study did not improve the sensitivity.

Limitations: Elastography when performed on nodules with a calcified shell may bias the stiffness of the lesion and give a falsely high strain ratio. In predominantly cystic lesions external pressure is not transmitted. Thus, elastography should be selectively used in nodules with calcifications and cystic changes.

CONCLUSION

The conventional ultrasound TI-RADS classification has long been used as the basis for the diagnosis of thyroid nodules. Based on the results of this study Sonoelastography may be considered a reliable screening tool for characterizing thyroid nodules. However, it does not increase the diagnostic accuracy when used as an adjunct with TIRADS.

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