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SONOELASTOGRAPHY OF THYROID NODULAR DISEASES WITH CYTOLOGICAL CORRELATION

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ABSTRACT

AIMS AND OBJECTIVES: 1. The aim of the study is to evaluate sonoelastography as a non-invasive investigating tool for thyroid nodular diseases. 2. The objective is to assess the accuracy of sonoelastography in differentiating malignant from benign thyroid nodular diseases.
MATERIAL AND METHODS: This is an observational prospective study and it was conducted over a period of 18 months from January 2014 – July 2015 involving 45 patients. They were evaluated using both B-mode and elastography. The mean shear wave velocity were correlated with FNAC diagnosis and subjected for statistical analysis.
RESULTS: Of 45 patients in the study, there were 43 female (96%) and 2 male patients (4%) with an average age of 35 years (range of 20–58 years). 4 patients had malignant nodules and 41 patients had a variety of benign nodule. We found the shear wave velocity (SWV) was higher in malignant nodules (5.0–6.0 m/sec) than in benign nodules (2.8–3.4 m/s) ($p < 0.001$, Student's t-test). The mean velocity for malignant nodules was 5.7 m/sec and benign lesion was 2.5 m/sec.
CONCLUSION: This study finds the shear wave elastography technique to be useful in evaluating thyroid nodules and considers it an invaluable complimentary method, just as Doppler ultrasound has been to Conventional ultrasound. Though it needs a reminder, that elastography is best interpreted with awareness of the causes for tissue stiffness.

KEYWORDS:

1 INTRODUCTION

From times immemorial manual palpation served as a source of information for evaluation of soft tissues and allowed detection of various diseases based on degree of hardness. During the last two decades, the ancient art of palpation gained new life due to numerous emerging elasticity imaging (EI) methods. Areas of applications of elastography imaging in medical diagnostics and treatment monitoring are steadily gaining a foothold. [1]

Sonoelastography is a relatively new technique that can be used for evaluation of tissue and lesions based on physical properties such as strain and shear wave to determine the hardness of the tissue. Many studies have been done to evaluate the benefits and possible clinical significance in evaluation of thyroid, breast, liver and other organs.

2 AIMS AND OBJECTIVES

1. The aim of the study is to evaluate sonoelastography as a non-invasive investigating tool for thyroid nodular diseases.
2. The objective is to assess the accuracy of sonoelastography in differentiating malignant from benign thyroid nodular diseases.

3 MATERIALS AND METHODS

All patients referred for ultrasound examination of thyroid were screened for thyroid nodules, and if found were subjected to elastography. We used ARFI shear wave elastography technique available in Siemens ACUSON S2000 as Virtual Touch™ tissue quantification (VTQ). An ROI cursor was placed on the site of interest and three samples were taken for each nodule. Their average values were taken for statistical analysis. Shear wave velocity (SWV) is displayed as m/sec.

FNAC of the thyroid nodules were not done immediately, rather it was performed on a later date in the presence of a pathologist. Nodules with suspicious B-mode features or with a threshold shear wave velocity (SWV) of > 4.0 were considered for FNAC. The cut-off shear wave velocity was deliberately selected at a lower level, from most studies, so as to include malignant lesions that might be softer in consistency than anticipated.

IMAGING TECHNIQUE

Patients were asked to lie in supine with neck extended. Then the patients were evaluated for thyroid nodules using B-mode ultrasound imaging. These nodules were then evaluated for tissue elasticity by taking three readings from each along the longitudinal plane, using a fixed-size ROI cursor of 6 × 5 mm. Their average shear wave velocities are then saved for FNA correlation and statistical analysis.

US-FNA CYTOLOGY

FNA cytology was performed using free hand technique. Patients were made to lie in supine position with neck extended, by placing a pillow under the shoulder. A 22-gauge needle and a 5 ml syringe were used to acquire the sample. It was performed under USG guidance using parallel technique.[2] We used 'combine method' for acquiring samples, [3] most of the samples were acquired by capillary technique. However, we used aspiration technique whenever needed. The slides were visually inspected for adequacy of samples by the pathologist.

STATISTICAL METHODS

Statistical analysis of the data was done using PSPP (GNU open source alternative to SPSS/IBM) version 0.8 for Windows and graphs were generated using Microsoft Excel 2007.

Descriptive and inferential statistical analyses were performed on the data acquired for the study. Descriptive statistics such as mean, median, standard deviation and range were evaluated. All comparisons were made by using Student's t-test and p-value < 0.05 were considered to indicate statistical significance.

4 RESULTS

There were total of 45 patients who met the study inclusion criteria, and out these patients we had 4 patients who had malignant nodules and 41 patients with benign nodules. The benign lesions consisted of nodular goitre (n=13) and colloid (n=28) while malignant lesion were all of papillary carcinoma (n=4).

The study consisted of 43 female (96%) and 2 male patients (4%) with an average age of 35 years (range of 20–58 years).

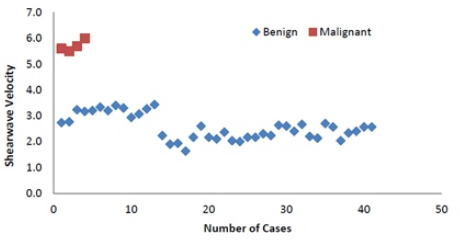

Figure 1 Scatter plot of benign and malignant samples based on their shear wave velocity

Figure 1 shows a clear demarcation between the shear wave elasticity between the two groups. The shear wave velocity (SWV) higher was much higher in case of malignant nodules (5.0–6.0 m/sec) than in benign nodules (2.8–3.4 m/s).

There was no overlapping of values in our study. This could be probably be due to small sample size, as lack of other forms of thyroid malignancy, which are known to show a softer consistency on elastography and hence occurrences of overlapping with benign nodules.

We found statistical significance with $p < 0.001$, when subjected to Student's t-test. The mean shear wave velocity for malignant nodules was 5.7 m/sec and benign lesion was 2.5 m/sec.

5 DISCUSSION

In this study we evaluated thyroid nodules using conventional ultrasound and sonoelastography. The tissue stiffness is recorded by measuring the shear wave velocity (SWV) using Virtual Touch tissue quantification (VTQ) mode in Siemens ACUSON S2000. The purpose of the study was to see if there is significant difference between the two groups, in terms of tissue elasticity.

Fa-Jin Dong et al. [4] conducted a meta-analysis of thyroid nodules using ARFI shear techniqu and found it useful in differentiating benign from malignant nodules. The pooled sensitivity, specificity, positive likelihood ratio, negative likelihood ratio, and diagnostic odds ratio of SWV in differentiating malignant and benign thyroid nodules were 86.3% (95%CI: 78.2-91.7), 89.5% (95%CI: 83.3-93.6), 7.04 (95%CI: 4.40-11.26), 0.17 (95%CI: 0.10-0.31), and 46.66 (95%CI:19.47-111.81), respectively.

Zhang et al. [5] also conducted a study to evaluate the diagnostic performance of ARFI to differentiate benign and malignant thyroid lesion. They found the ARFI elastography to improve the specificity in diagnosing malignant thyroid nodules compared with conventional US on its own. In their study they found ARFI elastography particularly facilitates the specific diagnosis for thyroid nodules smaller than 1.0 cm.

LIMITATIONS:

Firstly this study had limitations due to its sample size and limited time. Secondly the study was performed by a single operator, this limitation could result in operator-related selection bias. Also there was an initial phase of learning curve involved. Thirdly, all the malignant lesions in this study were of papillary carcinoma, and the lack of representation of other types of thyroid cancer may have affected the inference. Therefore, additional studies that include greater variety of thyroid tumors with a larger study group may be needed. Fourth, the gold standard for reference was FNAC. As this method is reported to have a indeterminate study of about 20%, the results of this study may have been affected. Therefore study based on biopsy correlation for indeterminate FNA may be needed.[6,7] Lastly, analysis of other confounding variables, like lesion depth, tumor size, histological grade and lymph node involvement were not performed.[8,9,10]

Thus, additional studies may be required to determine the correlations between elasticity values and other factors.

6 CONCLUSION

In our view, we find elastography a promising investigation tool for thyroid evaluation. However we need to be reminded that elastography is not a single technique, rather it consist of variation of various techniques, which has their own strengths and weakness. Further studies may be needed until we fully understand this tool and before we can say in which scenario it truly grants confidence beyond doubt.

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