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Thyroid Nodule Delineation: Role of Ultrasound Elastography

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ABSTRACT

Background: To check upon thyroid nodule (detected clinically or otherwise), with the possibility of thyroid cancer being real (~5%), it's important to evaluate them at the earliest.
Objective: To evaluate qualitative elastography patterns by using gray-scale and Doppler ultrasound (US) in patients presenting with thyroid nodules.
Methodology: Total 12 consecutive participants were selected and US & guided FNAB were performed. The results were recorded according to the Bethesda 2008 classification. Links between each gray-scale, power Doppler US feature, and cytology and the different elastographic patterns were calculated by applying Mc-Naemer's chi-square test.
Observations: Of 12 thyroid nodules that were examined on qualitative elastography, the strain pattern included a pattern type 1 in 1 patients (8.3%), pattern 2 in 6 patients (50%), and pattern 3 in 4 patients (33%). Pattern 4 was found in one (8.3%) case. Nine thyroid nodules (75%) showed colloid goitre, Two (16.7%) showed malignant and 1 (8.3%) showed thyroidits on cytopathological sample assessment.
.**Conclusion**: Although US elastography is easy to perform and not very time consuming, the intra-observer variability is high, thereby decreasing the US examination accuracy in differentiating benign from malignant thyroid nodules. The results must be corroborated in a larger population study.

KEYWORDS Thyroid Nodule, Elastography.

INTRODUCTION:
The term thyroid nodule refers to an abnormal growth of thyroid cells that forms a lump within the thyroid gland. Although the vast majority of thyroid nodules are benign (non-cancerous), a small proportion of thyroid nodules do contain thyroid cancer. In order to diagnose and treat thyroid cancer at the earliest stage, most thyroid nodules need some type of evaluation.

Neck ultrasound (US) examination is being used more widely these days; which has led to the detection of more number of asymptomatic thyroid nodules. [1] Of these nodules, approximately 5% turn out to be malignant on subsequent follow-up.[2] Fine-needle aspiration biopsy (FNAB) is the gold standard to differentiate malignant thyroid nodules from benign ones. But results take time, apart from disadvantage of procedure being invasive. [3] Specific gray-scale and Doppler US help to select which patients should be subjected to FNAB. [4]

Elastography US examination has been proposed & studied off-late as being able to discriminate malignant from benign thyroid nodules. Four different patterns have been described: "patterns 3 and 4" that suggest malignancy while "patterns 1 and 2" indicate thyroid nodule benignity. [5],[6]

The purpose of the present study was to evaluate qualitative elastography patterns by using gray-scale and Doppler ultrasound (US) in patients presenting with thyroid nodules & to evaluate the reproducibility of US elastography examinations.

METHODOLOGY

Study design: Prospective observational study.

Study setting: Tertiary-care Hospital.

Study duration: September 2015-February 2016

Sample size: Total 12 consecutive participants undergoing US guided FNAB.

Thyroid US examinations were performed by a single radiologist with 2-year experience in thyroid imaging. All gray-scale and Doppler US examinations were performed by using a 4-13 MHz linear probe, after having focused and magnified the thyroid nodule. Qualitative elastography was performed using slight pressing up and down motion of the probe on the patient's neck. Image acquisitions and interpretation of the examination were performed except in case of thyroid nodules exhibiting a cystic component of mixed echostructure (liquid/solid). US examination and US-guided FNAB of the thyroid nodule were performed by the same radiologist operator on the same day. Thyroid nodule FNAB was repeated three times on the same nodule by using a 21-G needle under real-time US guidance. All cytologic examinations were performed by the same cytopathologist who had a 10-year experience in thyroid cytology assessment. The results were recorded according to the Bethesda 2008 classification. Links between each gray-scale, power Doppler US feature, and cytology (abundance of cellularity-colloid substance) and the different elastographic patterns were calculated by applying Mc-Naemer's chi-square test.

Written informed consent was elicited from the participants.

Necessary approval from the Institutional Ethics Committee was before conduction of the study.

OBSERVATIONS

A total of 12 consecutive patients (10 women and 2 men) with mean age 43 years (range- 9 to 77 years) underwent US and US-guided FNAB of thyroid nodule.

The mean volume of the nodules was 4.9ml (range 0.7-9.1 ml). The nodule did not exhibit any cystic component in 6 cases (50%). The solid component was found heterogeneous in cases (66.6%). Colloid granulations were observed in five nodules (41%) and macrocalcifications in three nodules (25%). The operator found one microcalcification within the study nodules that were examined. The mean anteroposterior/ transverse diameter ratio was 1.6 cm (1.0-2.3cm). The nodule margins were ill-defined in two cases. None of the nodules showed a well-limited halo at the periphery. Two nodules (16%) showed limited vascularization at the nodule periphery exclusively. Regarding thyroid nodule vascularization classification, two nodules (16%) exhibited type 1, 5 (41%) type 2, and 5 (41%) showed type 3 pattern at quantitative vascularization assessment.

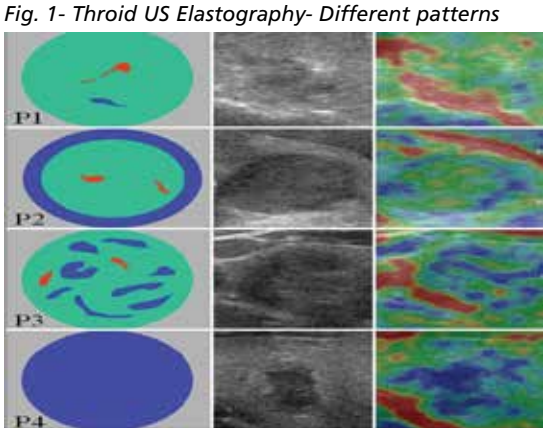
Of 12 thyroid nodules that were examined on qualitative elastography, the strain pattern included a pattern type 1 in 1 patients (8.3%), pattern 2 in 6 patients (50%), and pattern 3 in 4 patients (33%). Pattern 4 was found in one (8.3%) case.

Nine thyroid nodules (75%) showed colloid goitre, Two (16.7%) showed malignant and 1 (8.3%) showed thyroidits on cytopathological sample assessment.

DISCUSSION

Qualitative US elastography is presumed to be useful tool to add to the US semiology of thyroid nodule assessment, and has been integrated in the Thyroid Imaging Reporting and Data System (TIRADS) classification of thyroid nodules. [7] In this study, we performed qualitative elastographic examinations. Results were displayed into four different patterns reflecting increasing tissue stiffness [Figure 1]. [6]

Fig. 1- Throid US Elastography- Different patterns



In their prospective study, [6] Kagoya et al. found 36% (13 out of 36) of benign nodules and 72% (8 out of 11) of malignant nodules showing either pattern 3 or 4. However, the authors did not mention how many benign/malignant nodules exhibited pattern 3 and how many exhibited pattern 4. In the present study, all the examined thyroid nodules were cytologically proven benign on US-guided FNAB examination and 23% of these benign nodules showed pattern 3. As this pattern was sometimes noted in benign nodules, we state that this pattern is not strongly specific of malignancy, thus should not be taken alone as a strong indicator leading to thyroidectomy. According to our 2-year thyroid nodule qualitative elastography experience, pattern 4 (that was not reported in this series of benign nodules) seems to be far more specific of malignancy. However, we found that when a malignant thyroid nodule exhibited pattern 4 on elastography examination, in any case, the B-mode ultrasonography was found to be strongly suggestive of the thyroid nodule malignancy. As a matter of fact, at least one of the following items including "strong hypoechogenicity," "microcalcifications," and "ill-defined margin features" was observed, leading to the scoring as grade 4 or 5, according to the TIRADS classification, whatever thyroid nodule elastography pattern was found. [4],[7]

Multiple elastography acquisitions per single thyroid nodule were performed to assess the intra-observer reproducibility. We noted a poor reproducibility of the elastography grading including at least two different patterns per nodule that was found in half of the examined nodules. In three cases, the three patterns 1, 2, and 3 were displayed. Although we consider that misgrading patterns 1 and 2 when involving "benign" thyroid nodules does not have any consequences on the patient's prognosis and follow-up, the intra-observer variability of grading pattern 3 is more challenging. Such variability (23%) suggests that the qualitative elastographic examination may not be so accurate to guide the patient management (e.g. follow-up, FNAB, or surgery). Ning et al., found that a semi-quantitative strain ratio between the nodule and the adjacent normal thyroid tissue was a useful characterization index. [8] In their study, thyroid lesions were assessed at least three times and strain average value was recorded. However, information regarding each of these different values was not given; therefore, one cannot draw any definitive conclusion on the strain measurement variability. Finally, recent studies highlighted the presence of a significant inter-observer variability of US elastography in thyroid and breast lesions. [9],[10]

We guess that the intra-observer variability may be explained by the basic technical aspect of elastography pattern acquisition. As a matter of fact, elastography measurement acquisition requires iterative up and down US probe pressures that indeed depend on the operator strength and also may vary over time with the same individual. Thus, it explains that the elastography acquisition pattern might vary for each acquisition. It has been argued that the use of carotid artery pulsations as a compression source may reduce such an acquisition variability. [11]

Conversely, the true quantitative shearwave elastography [12],[13] does not require iterative compressions and is quite promising due to its insensitivity to lesion size, reproducibility (operator independence), quality, and accuracy. This technique, which allows true quantitative measures of the examined tissue stiffness (in kPa), may also show intra-/inter-observer variability. [14] Indeed, we guess that performing a ratio between absolute strain measure of tumor and normal adjacent thyroid tissue may be more objective and reproducible than qualitative color elastogram acquisition, therefore diminishing the intra- and inter-observer variability.

One limitation of our study was the absence of histopathologic examination as the reference standard to assess the thyroid nodule benignity. Indeed, a false-negative rate of 1-11% is expected when using a sample cytologic examination. As a matter of fact, the diagnosis of follicular carcinoma might be particularly uneasy even with histopathologic examination. Thus, one cannot rule out that some cases exhibiting pattern 3 might be malignant thyroid follicular neoplasms. Another limitation of our study was the absence of assessment of the inter-observer variability. Finally, the results of our study, which only involved 26 patients, must be corroborated in a larger population study.

REFERENCES

1. Guth S, Theune U. Very high prevalence of thyroid nodules detected by high frequency (13 MHz) ultrasound examination. Eur J Clin Invest 2009;39:699-706.
2. Baier ND, Hahn PF et al. Fine-needle aspiration biopsy of thyroid nodules: Experience in a cohort of 944 patients. Am J Roentgenol 2009;193:1175-9.
3. Gharib H, Goellner JR. Fine-needle aspiration biopsy of the thyroid: An appraisal. Ann Intern Med 1993;118:282-9.
4. Kim EK, Park CS et al. New sonographic criteria for recommending fine-nee-

dle aspiration biopsy of nonpalpable solid nodules of the thyroid. AJR Am J Roentgenol 2002;178:687-91.

5. Ophir J, Céspedes I. Elastography: A quantitative method for imaging the elasticity of biological tissues. Ultrason Imaging 1991;13:111-34.
6. Kagoya R, Monobe H, Tojima H. Utility of elastography for differential diagnosis of benign and malignant thyroid nodules. Otolaryngol Head Neck Surg 2010;143:230-4.
7. Horvath E, Majlis S, Rossi R, Franco C, Niedmann JP, Castro A, et al. An ultrasonogram reporting system for thyroid nodules stratifying cancer risk for clinical management. J Clin Endocrinol Metab 2009;94:1748-51.
8. Ning CP, Jiang SQ, Zhang T, Sun LT, Liu YJ, Tian JW. The value of strain ratio in differential diagnosis of thyroid solid nodules. Eur J Radiol 2012;81:286-91.
9. Yoon JH, Kim MH, Kim EK, Moon HJ, Kwak JY, Kim MJ. Interobserver variability of ultrasound elastography: How it affects the diagnosis of breast lesions. AJR Am J Roentgenol 2011;196:730-6
10. Park SH, Kim SJ. Interobserver agreement in assessing the sonographic and elastographic features of malignant thyroid nodules. AJR Am J Roentgenol 2009;193:W416-23.
11. Luo S, Lim DJ, Kim Y. Objective ultrasound elastography scoring of thyroid nodules using spatiotemporal strain information. Med Phys 2012;39:1182-9.
12. Sebag F, Vaillant-Lombard J et al. Shear wave elastography: A new ultrasound imaging mode for the differential diagnosis of benign and malignant thyroid nodules. J Clin Endocrinol Metab 2010;95:5281-8.
13. Bercoff J, Tanter M, Fink M. Supersonic shear imaging: A new technique for soft tissue elasticity mapping. IEEE Trans Ultrason Ferroelectr Freq Control 2004;51:396-409.
14. Marcy PY, Thariat J, Lacout A. Should we catch the train of shear-wave elastography? AJR Am J Roentgenol 2012;198:W624-5.