The Utility Of Ultrasonographic Elastography And Micropure Imaging In Differentiation Of Benign Thyroid Nodules From Malignants

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Purpose

Thyroid nodules are common finding in general population, especially in areas of iodine deficiency. The great majority of thyroid nodules are benign, less than 5% of them are malignant (1). Ultrasonography is non-invasive, easily available imaging technique in evaluation of thyroid nodules. Many studies have been reported on the utility of ultrasonography in the predictive value of this technique on the differentiation of benign thyroid nodules from malignant ones (1-5). Presence of calcification, hypoechogenicity, irregular margins, absence of a halo, predominant solid composition have been reported as to be the features associated with an increased risk of malignancy. However, the sensitivity, specificity, and negative and positive predictive values for these features are extremely variable in different studies, and there is not any ultrasonographic feature with a high sensitivity and a high positive predictive value for diagnosis of thyroid cancer.

Real time ultrasonographic elastography is newly developed dynamic imaging technique, displays tissue elasticity by measuring the degree of distortion under the application of an external force. Like palpation, ultrasonographic elastography uses tissue deformation or strain, caused by external compression and is based on the pre-compression and compression ultrasonic signals. Ultrasonographic elastography is used to examine several organs such as; breast (6, 7), thyroid (8), prostate (9), cervix (10), and liver (11). This technique is promising imaging technique that can be used in the differentiation of benign thyroid nodules from malignant nodules. However, to our knowledge, only limited numbers of studies have been reported on real time ultrasonographic elastography application on benign and malign thyroid nodules (12).

Micropure imaging algorithm is an adapted filter that is used to enhance bright echoes to visualize calcifications, to show calcifications, especially microcalcifications easier.

The purpose of this study was to evaluate the utility of ultrasonographic-elastography and micropure imaging in the differential diagnoses of benign thyroid nodules from malignant ones.

Methods and Materials

This was a prospective study. The study protocol was approved by the hospital review board; written informed consent was received from all patients for undergoing both real time ultrasonographic elastography and micropure imaging.

From February 2010 to April 2010, 74 consecutive patients (66 female, 8 male; age ranged 21-80 years, mean age 51±12.7 [standard deviation] years) with thyroid nodules
who referred for fine-needle aspiration biopsy, in which the final diagnose was not known, were prospectively examined.

All patients were examined with gray scale, micropure imaging, and real time ultrasonographic elastography with a linear transducer (10 MHz, Apio, Toshiba, Ottawa, Japan), by two radiologists. One of the radiologists' had 20 years’ and the other had 7 years' experience with gray scale ultrasonography performed the gray scale, and real time ultrasonographic elastography. All interpretations performed before biopsy, and the radiologists were blinded to the patients' final diagnosis. Decisions regarding the findings were reached by consensus.

Gray-scale ultrasonography and micropure imaging was performed first for all patients. Real time ultrasonographic elastography was performed in second step, by using the same probe.

For real time ultrasonographic elastography, repeated compression with light pressure from upward to downward direction followed by decompression was performed. Strain value ratio (strain index) of thyroid parenchyma to thyroid nodule was calculated.

All of the patients underwent fine-needle aspiration biopsy. The time interval between real time ultrasonographic elastographic evaluation and biopsy were less than 5 days. Cytological diagnosis of the thyroid nodules were compared with real time ultrasonographic elastography and micropure imaging features.

STATISTICAL ANALYSIS

Quantitative variables were compared by using the Mann-Whitney U test. Qualitative variables were compared by using the $X^2$ test. Quantitative data are presented as means ± standard deviation. P ≤ 0.05 indicated statistical significance. The statistical analyses were performed by using SPSS 13.0.

Results

By using micropure imaging, 54 (80.6 %) of 67 benign thyroid nodules and 3 (42.8 %) of 7 malignant thyroid nodules had microcalcification (Figure 1). The sensitivity, specificity, negative predictive value, positive predictive value, accuracy rate, of micropure imaging was 42.9 %, 80.6 %, 93.1 %, 18.8 %, 77 %, respectively. The sensitivity, specificity, negative predictive value, positive predictive value and accuracy rate of strain index values were 85.7 %, 82.1 %, 98.2 %, 33.3 %, and 82.4 %, respectively when the best cut off point of 2.24 was used (p=0.001). The P (x=malign) was 0.96 for the strain index value higher than 2.24 (Figure 2).
Fig. 1: MicroPure image of thyroid nodule shows microcalcifications. After fine-needle aspiration biopsy the diagnosis was Papillary carcinoma.
Fig. 2: Elastogram shows a thyroid nodule at right isthmic portion with elasticity index of 5.44. After fine-needle aspiration biopsy, the final diagnoses was papillary carcinoma.
Conclusion

One of the oldest clinical skills, palpation, provides information about the stiffness of soft tissues, by using an external compression and the deformation of the tissue. Palpation is subjective examination technique. Elasticity measurements and stiffness evaluation of soft tissues have been reported to be useful in differential diagnosis of tumor, inflammation and normal tissue. Generally, it is accepted that, benign soft tissue lesions are firmer than normal tissue but softer than cancers (13-15).

Recently developed promising imaging technique called as real time ultrasonographic elastography reveals the physical properties of soft tissue by characterizing the difference in elasticity between the region of interest and the surrounding normal soft tissue by using manual compression and deformation of that tissue. The degree of deformation of the soft tissue is calculated and combined to gray scale ultrasound image as elastography map to evaluate the tissue stiffness.

Some of the major advantages of real time ultrasonographic elastography are, performing easily, noninvasively, and suitable to used during routine ultrasound examinations. In addition, this imaging technique allows the dynamic visualization of lesions during compression.

Lyshchik et al. prospectively evaluated the sensitivity and specificity of ultrasonographic elastography for differentiating benign and malignant tumors of thyroid gland (7). They have reported that, thyroid lesions such as cysts, benign and malignant nodules had different elastographic characteristics. Cysts were dark lesions on elastograms. Solid nodular lesions were stiffer than thyroid gland tissue, and also malignant lesions were significantly stiffer than benign thyroid nodules. They have suggested that a strain index value greater than four is the strongest independent predictor of thyroid gland malignancy (p<0.001) and had a 96% specificity and 82% sensitivity (7).

Micropure imaging algorithm is recently developing imaging technique that aids in detection of the calcifications easiler, by enhancing the superficial structures.

Kurita, evaluated the usefulness of micropure imaging in microcalcifications of breast lesions (16). He have been reported that, micropure imaging can improve the visualization of microcalcification and also suggested that this imaging algorithm is clinically useful, easy imaging technique.

Sankaye et al, examined breast ultrasonography of 25 woman, and eleven breast malignancies were diagnosed (17). Overall patients four (16%) (three malignant and one benign) calcifications were visualised by ultrasound. All were detectable using both B-mode and MicroPure imaging. They have suggested that, subjectively all four were felt to be more conspicuous using B-mode than MicroPure imaging.
In our study the sensitivity, and specificity predictive value and accuracy rate of strain index values were 85.7 %, 82.1 %, and 82.4 %, respectively when the best cut off point of 2.24 was used. By using micropure imaging, 54 (80.6 %) of 67 benign thyroid nodules and 3 (42.8 %) of 7 malignant thyroid nodules had microcalcification.

In conclusion, elastography is a promising imaging technique that can assist the differential diagnosis of malignant and benign thyroid nodules. Combination of real time ultrasonographic elastography, micropure imaging techniques to B-mode ultrasonography may be helpful to improve the differential diagnosis of thyroid malignancies.

References


Personal Information