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Diagnostic accuracy of the combined use of conventional sonography and sonoelastography in differentiating benign and malignant solitary thyroid nodules

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KEYWORDS

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Abstract *Objective:* To assess the diagnostic accuracy of combined use of conventional grayscale US and sono-elastography in differentiating benign and malignant solitary thyroid nodules.
Materials and methods: This prospective study included 50 patients with solitary thyroid nodules being evaluated using grayscale US followed with sono-elastography (USE). Suspicious conventional sonographic data for malignancy then evaluated using USE were classified according to Rago criteria with calculation of strain ratio. The diagnostic performances of grayscale US, elastography with Rago criteria, for predicting thyroid malignancy were compared and cutoff value for strain ration was statistically analyzed. Finally all patients with solitary nodule were subjected to US-guided FNAC and 35 patients recommended for surgery in the form of 12 patients underwent total thyroidectomy and 23 patients underwent thyroidectomy with neck dissection.
Results: 30 females (60%), and 20 males (40%) were included (Mean age 38) with final diagnosis comprised 29 (58%) pathologically proved benign thyroid nodules and 21 (42%) pathologically proved malignant nodules. US showed significant relation between markedly hypo-echogenicity, oval than tall, margin irregularity, presence of micro-calcification with diagnosis of thyroid malignancies with p value <0.001. Regarding sonoelastography, there was significant relation between elastography scores 4 and 5 and thyroid malignancies showing sensitivity of 80%, a specificity of 100%, and p value <0.001. The most accurate strain ratio cutoff value among studied cases was 2.52. Combination of grayscale US and sono-elastography yielded better results with sensitivity of 92%, specificity of 95%, PPV of 89%, NPV of 92% and diagnostic accuracy or efficacy of 96%.

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Conclusion: Combined use of USE and grayscale US, showed superior performance in the differentiation of malignant and benign thyroid nodules compared with each technique alone. Suspicious US criteria with elasticity Rago scores 4 and 5 and strain ratio more than 2.52 are the most predictive signs of malignancy.

1. Introduction

Thyroid nodules presented commonly as they are found in 4–8% of adults by palpation, in 10–41% by ultrasound either intentionally or incidentally, and in 50% by pathologic examination at autopsy.[1] Inspite of high prevalence of nodules, thyroid cancer is relatively rare and not more than 6% of all nodules being malignant; however, thyroid cancers generally have good prognosis and fortunately, early diagnosis and treatment is fruitful.[2]

Common presentation of cancer thyroid is solid solitary nodule and therefore, it is crucial to differentiate between the benign and malignant causes and hence it is essential to have a strategy determining which nodules candidates for fine needle aspiration cytology.[2,3]

Ultrasound has a wide utility more than confirming presence of thyroid nodules and assessment of its size, texture and vascularity as it added helpful information about the qualitative characterization of thyroid nodules based on benign or malignant features.[4,5]

Experienced hand palpation can give initial idea about nodule stiffness, and hence, can suggest possibility of being malignant, considering that the more firm nodules are likely to be malignant. On the other way, deep or small nodules are hardly evaluated by palpation and recently, used the elasticity imaging, namely sono-elastography (USE), that estimates the tissue mechanical properties in vivo using complementary conventional US systems with modified software.[6,7]

The idea of its application depends upon low-amplitude, low-frequency shear waves that are propagated through thyroid gland and whenever hard inhomogeneity, for example tumor, is present, a decrease in the vibration amplitude will occur at its location. Under a certain applied force, stiff tissue shows less strain than softer tissue. Thus, by measuring tissue strain induced by compression we can obtain tissue stiffness information.[8,9]

Thyroid gland is well positioned for elastographic examination due to superficial and anterior location, and so could be easily compressed against underlying anatomic structures by US probe.[10,11] Tissue deformation or strain caused by compression is estimated with pre- and post-compression ultrasonic signals. Regarding fundamentals of sonoelastography, it is proposed that elastic modulus for malignant thyroid nodules is significantly higher than that for normal thyroid tissue and benign nodules, which establishes the idea for application of USE in assessment of the nature of nodules.[12–14]

Multiple variable sonoelastography scores, depending on the color changes or numerical estimation of the degree of stiffness are applied. Rago's scoring system is the commonest, representing five-degree elastography qualitative evaluation system that can be applied to thyroid nodules using a scale of 1–5 with color coding varied from green (most benign) to blue (most malignant).[15]

Other numerical methods such as estimating strain ratio (calculated as the ratio of stiffness between nodular tissue and surrounding normal thyroid tissue) could be of help to differentiate benign from malignant solitary thyroid nodules besides using the color scale.[16]

To address terminology and other issues related to thyroid fine-needle aspiration (FNA), the National Cancer Institute (NCI) hosted the NCI Thyroid FNA State of the Science Conference. The conclusions regarding terminology and morphologic criteria from the NCI meeting led to the Bethesda Thyroid Atlas Project and form the framework for The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC). Bethesda classification is graded into 6 grades according to degree of risk of malignancy linked with recommended clinical management.[17]

Objective was to evaluate combined role of grayscale US criteria with help of USE as a recent screening modality in differentiating benign from malignant solid thyroid nodules.

2. Patients

Current prospective study was conducted from 1–2014 to 5–2015 on selected 50 patients having solitary thyroid nodule either by clinical palpation or by conventional US neck examination, who were referred to Radiology department.

2.1. Inclusion criteria

Patients with palpable solitary thyroid nodule, those of solid or predominantly solid nature (75% or more solid consistency), patients with incidentally noted thyroid nodules during US or CT neck examination for other reasons, patients who had conclusive FNA result and/or underwent surgery after US examination.

2.2. General exclusion criteria

Patients with non-conclusive final pathological diagnosis, patients having more than one nodule or multiple confluent thyroid nodules with ill-defined margins. *Regarding USE examination*, we excluded nodules more than 4 cm in diameter to have enough surrounding residual normal thyroid tissue to be compared with the nodule, using either color or numerical scales. Cystic (or predominantly cystic nodules) and nodules having egg-shell calcification were excluded.

This was explained as posterior enhancement of the cysts or posterior shadowing of the calcification will obscure the posterior margin of the nodules and so interfere with accurate elastography scoring. Also technical limits for applying USE in cystic nodules (as classic elastogram for a cyst consists of three color layers {blue–green–red} from top to bottom) and macrocalcifications (coarse or egg shell) have hard blue appearance

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