Medical sciences (2018) 1–3

Index Medicine International

Medical Sciences
Official website :
www.medicsciences.com

The role of combined ultrasonography methods in differentiating benign and malignant thyroid nodules

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ABSTRACT

Introduction: tyhyroid nodules (TN) are a common finding in clinical practice. While most of the nodules are benign, less than 10% prove to be malignant. US is a low-cost, non-invasive, safe imaging examination, which is able to qualitatively analyze the nodule's features. [1, 2, 4, 10] To this date, there is no US sign which is considered to be pathognomonic of malignancy, however, combining multiple US methods, such as strain elastography (SE), shear-wave elastography (SWE) and ultrasound guided fine-needle aspiration (FNA), helps to determinate the risk of malignancy in a TN. [5]

Aim: to review scientific literature and emphasize the features of ultrasonographic methods, which are used in the differentiation between benign and malignant thyroid nodules.

Materials and methods: literature analysis. A research of articles in the English language on the "PubMed" 2012 to 2017 database. Keywords used in the search: "thyroid nodule", "ultrasonography", "benign", "malignant".

Results: studies show that conventional US is widely used to help predict the malignancy of TN. Individual US features cannot be used to make an accurate diagnosis of thyroid cancer. Cystic content and spongiform appearance, however, might estimate the presence of benign nodules, but the clinical applicability of these features is limited due to their infrequent occurrence. Since none of the US signs are considered pathognomonic, it is important to determine a correlation between them. [3, 9] The use of different US methods, when evaluating TN, improve the diagnostic value. [1] SE and SWE are used in clinical practice to evaluate TN by comparing tissue elasticity. FNA biopsy is one more diagnostic method, which plays a major role in the differentiation between benign and malignant TN. [4] The diagnostic accuracy of US-FNA for TN varies, ranging from 60% to 96%. [15]

Conclusions: evidence suggests that individual US features cannot be used to confirm thyroid cancer. A combination of conventional US and other methods, such as SE, SWE and FNA have a major impact on the diagnostic value and facilitate the differentiation between benign and malignant TN.

Keywords: thyroid nodule, ultrasonography, benign, malignant.

List of abbreviations

US – ultrasonography
FNA – fine needle aspiration
TN – thyroid nodule
SWE - shear-wave elastography
SE - strain elastography
FNA - fine-needle aspiration

Introduction

Thyroid nodules (TN) are a common finding in clinical practice. While most of the nodules are benign, less than 10% prove to be malignant. Approximately 4%-7% of TN are diagnosed by palpation. Nodules, that can be found by using physical examination, are usually larger than one centimeter. Their location inside the thyroid gland, the experience of the examiner, and the anatomy of the patient also have a major impact on the palpability. Therefore, a more accurate imaging examination, such as conventional ultrasonography (US), is recommended for the primary evaluation of a TN. The use of US has increased the rate of diagnosis of TN to 67%. After verification of a TN, US plays a major role in the differentiation between benign and malignant nodules. [1, 2, 4, 10] US is a low-cost, non-invasive, safe imaging examination, which is able to qualitatively analyze the nodule's features. To this date, there is no US sign which is considered to be pathognomonic of malignancy, however, combining multiple US methods, such as strain elastography (SE), shear-wave elastography (SWE) and ultrasound guided fine-needle aspiration (FNA), helps to determinate the risk of malignancy in a TN. [5]

Materials and methods

Literature analysis. A research of articles in the English language on the "PubMed" 2012 to 2017 database. Keywords used in the search: "thyroid nodule", "ultrasonography", "benign", "malignant."

Results

Studies show that conventional US is widely used to help predict the malignancy of TN. The signs of malignancy, that can be found during US, are: hypoechogenicity of the nodule, solid component, asymmetric margin, calcifications, the absence of a halo, and central vascularity in the colour Doppler mode. [11] On the other hand, there are features which suggest that a TN is likely to be benign, such as: spongiform structure, cysts, hyperechogenicity, colloid crystals, an eggshell calcification, and a thin, regular halo. [8] The risk of malignancy does not increase with a higher number of nodules. [10] Individual US features cannot be used to make an accurate diagnosis of thyroid cancer. Cystic content and spongiform appearance, however, might estimate the presence of benign nodules, but the clinical applicability of these features is limited due to their infrequent occurrence. Since none of the US signs are considered pathognomonic, it is important to determine a correlation between them. [3, 9]

The use of different US methods, when evaluating TN, improve the diagnostic value. [1] SE and SWE are used in clinical practice to evaluate TN by comparing tissue elasticity. [6] In SE, quantitative evaluation can be made by measuring the response to the mechanical pressure (compression or vibration) applied to the examined and surrounding tissues. [13] SWE measures the velocity of shear waves that are induced by series of acoustic radiation force impulses which are elicited by the ultrasound probe and tracked by standard ultrasound waves. [14] Normal thyroid tissue exhibits lower stiffness, while malignant TN consist of more histological solid components, but less intercellular substance and exhibit greater stiffness and smaller elasticity. [12]

FNA biopsy is one more diagnostic method, which plays a major role in the differentiation between benign and malignant TN. [4] FNA can be performed in two ways: using palpation or with ultrasound guidance. Ultrasound guided FNA is preferred for nodules, which are difficult to palpate, predominantly cystic or posteriorly located. [7] In clinical practice, US guided FNA is performed when a TN possesses US features associated with high risk of malignancy, which were mentioned previously. The diagnostic accuracy of US-FNA for TN varies, ranging from 60% to 96%. [15]

Discussion

The accuracy of different US methods depends on the experience of the operator, and the type of cancer and nodule. [3] It is common that thyroid cancer does not always have ultrasound features of malignancy. In other words, it is hard for clinicians to determine whether the nodule is malignant or not. [2] In such clinical cases, FNA biopsy is considered a "golden standard" in the differentiation between benign and malignant TN. However, this examination needs to be executed selectively, due to the potential non-diagnostic results, associated costs, and the risk of overdiagnosis. Up to 15-30% of FNA biopsies are classified as non-diagnostic or indeterminate. In this case, US is an effective method to indicate patients, whose thyroid nodules are likely to be malignant and reduce the number of needless FNA biopsies. US elastography is another method, that is used to improve diagnostic accuracy. Despite its value in predicting malignancy, this examination has certain limitations. Fibrosis within both benign and malignant nodules can increase stiffness and this can cause a false positive result. Tissue stiffness can also increase when

using high degrees of compression if the tissue stiffness of the nodule is non-linear. It is complicated to adequately compress thyroid nodules in strain imaging, which are greater than 3 cm in diameter. What is more, US elastography is less accurate when nodules have cystic content, as fluid movement does not reflect stiffness of the solid tissue. US elastography cannot be performed in the occurrence of eggshell calcification, because the sound waves do not penetrate the calcified border and it is impossible to evaluate the central non-calcified portion of the nodule. [4, 16]

Conclusions

Evidence suggests that individual US features cannot be used to confirm thyroid cancer. Cystic content and spongiform appearance might estimate the presence of benign nodules, but the clinical applicability of these features is limited due to their infrequent occurrence. [3] A combination of conventional US and other methods, such as SE, SWE and FNA have a major impact on the diagnostic value and facilitate the differentiation between benign and malignant TN.

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