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THE ROLE OF COMPLEX ULTRASOUND IN FOCAL CHANGES OF THE THYROID GLAND

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Abstract
The purpose of this study is to evaluate the role of shear wave elastography in the framework of a comprehensive ultrasound examination in the differential diagnosis of focal thyroid formations. 134 patients with various nodular pathology of the thyroid gland were examined before surgery. The data of a comprehensive ultrasound examination using color Doppler mapping and the technique of shear wave sonoelastography were comparable with the results of morphological examination during thyroid biopsy. We came to the conclusion that the use of elastography as part of a comprehensive ultrasound examination provides valuable information about the characteristics of the node, which helps in the differential diagnosis of thyroid cancer.

Keywords: ultrasound examination, color Doppler mapping, shear wave elastography, thyroid cancer.

Introduction

Focal thyroid diseases are one of the significant problems of modern endocrinology. Since the 2000s, there has been a steady increase in focal and diffuse thyroid diseases (thyroid gland). During ultrasound examination, various nodular formations are detected in more than 20% of the population, and in 3% of cases, the thyroid node is cancer, regardless of the size of the pathological focus. The incidence of thyroid nodules has increased from 4-9% to 15-22% over the past 30 years, and thyroid cancer has increased more than 2 times [1, 2, 3]. The prognosis for thyroid nodules largely depends on the early diagnosis of the disease. Despite significant achievements in radiation diagnostics, none of the methods of medical imaging makes it possible to distinguish benign thyroid pathology from malignant [4, 5].

In scientific works devoted to the problems of thyroid pathology, much attention is paid to ultrasound diagnostics [6, 8, 9]. This method is based on determining the volume of the thyroid gland, assessing its echogenicity and echostructure, and types of nodular vascularization calls. In recent years, a number of papers have been published on the study of the thyroid gland using the elastography method [7]. Pathologically altered tissues are characterized by an increase in stiffness and a decrease in the ability to deform. The elastography method is based on obtaining quantitative and qualitative differences in elastic properties (elasticity, stiffness and extensibility) of normal

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and pathologically altered tissues. However, each of the currently used diagnostic criteria does not allow us to obtain complete information about the nature of changes in the thyroid gland. Often, the results of ultrasound examination are contradictory. It is possible to speak about the malignant nature of focal formations only with a greater or lesser degree of probability. The verification method of focal thyroid formations is still a fine needle aspiration biopsy with cytological examination. All this indicates the need to further improve existing and develop new informative methods used in the diagnosis of focal lesions of the thyroid gland, followed by determining their place in the diagnostic algorithm.

The purpose of this study

The aim is to determine the informational significance of ultrasound examination criteria for the development of a differential diagnostic algorithm for the detection of focal thyroid formations.

Materials and methods of research

134 patients were examined to determine the diagnostic significance and validity of the proposed algorithm for complex ultrasound diagnosis of thyroid diseases. Ultrasound examination in the gray scale mode in combination with color Doppler mapping (CDM) and shear wave sonoelastography was included in the comprehensive examination for all patients. The study was conducted on an ultrasound device "Aixplorer" from the company "Super Sonic imagine" (France) with a frequency range of 6-12 MHz linear sensor. The final diagnosis of the examined patients was confirmed by histological examination of the surgical material.

At the final stage, ultrasound in shear elastography (SEG) mode was performed as part of a comprehensive study of the thyroid gland. Depending on the degree of stiffness and elasticity of the most suspicious area of the focal formation of the thyroid gland, elastographic images were classified into 3 types of color staining and the corresponding range of values of the Young's modulus as follows:

Type 1 is uniform blue staining (low values of Young's modulus), typical for unchanged thyroid parenchyma and surrounding tissues.

Type 2 is a mosaic structure with a predominance of blue areas and several denser green areas (average values of the module

The cabin boy).

Type 3 is a mosaic structure with red sections (high values of Young's modulus). Quantitative elastometry was performed using one of the Young's modulus (MU) equations (e=3c2, where c is the shear wave velocity).

The results of the study

Standard ultrasound examination in the control group of patients (group I) revealed no pathological changes in the structure of the thyroid gland; there are no areas of abnormal blood flow in the CDC mode. When studied in the SEG mode, the average stiffness (Young's modulus) of the unchanged thyroid parenchyma was 12.65±5.45 kPa. In all cases, the first type of elastogram staining was observed. In the II clinical group (solitary follicular adenomas without signs of atypia), oval or rounded formations of various sizes, echogenicity and structure, with clear, even contours, were determined in the structure of the thyroid gland in the standard B-mode.

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It was possible to visualize a thin connective tissue hyperechoic capsule only in 69% of cases. In 84.8% of cases, a thin hypoechoic rim (including around the capsule) was visible – a "halo" corresponding to the vascular perinodular ring in the CDK mode, a peripheral type of blood flow. A distinctive feature of adenoma in 7 cases (15.9%) was pronounced hypervascularization, which creates the effect of a "burning" node when examined in the CDC mode – a mixed type of blood flow. In the gray scale mode, this node appeared to be a hypoechoic formation of a homogeneous structure, mainly with clear, even contours.

In the III clinical group (histologically verified papillary and medullary thyroid cancers), the pattern of focal thyroid changes in the B-mode was characterized by heterogeneity of the echographic pattern and was represented by 4 different ultrasound variants. In the CDC mode, malignant nodes were characterized by an intranodular type of blood flow in 28 (62.2%) cases, less often by mixed and perinodular types (30% and 7.8%, respectively); at the same time, the intensity of blood supply to the formation did not always depend on its size. In all cases, pathological angioarchitectonics took place. When examined in the SEG mode, the average stiffness value in the structure of the most suspicious areas was 196.45±24.23. The third type of staining prevailed on elastograms – in 38 (84%) cases (Fig. 3); in other cases, staining according to the second type was observed – in 7 (16%) cases.

Discussion of the results of the study

To assess the informative value of ultrasound markers of nodular formations and develop a diagnostic algorithm based on this, discriminant analysis was used, the essence of which is as follows. All ultrasound parameters are evaluated by their contribution to the division of patients into 3 groups, differing in the degree of severity of proliferative changes. Then from the whole group of signs

The most informative ones are highlighted, and an algorithm is based on them. The discriminant analysis was performed on ultrasound signs of nodular formations of the thyroid gland, detected during examination in the gray scale mode, Dopplerography, shear wave elastography, as well as TAPB.

In the process of mathematical processing of the results of echography, it was found that such a traditionally described feature as the volume of the thyroid gland and the size of the nodular formation has extremely low diagnostic accuracy – 45% and is not a significant parameter for the differential diagnosis of benign and malignant tumors of the thyroid gland.

The existence of these signs indicates only the presence of thyroid pathology, which explains the low informational contribution of these signs to the diagnosis process. The most specific (93%) sign of thyroid cancer should be recognized as the presence of calcifications in focal formations, which is consistent with the literature data, but the low sensitivity of the sign (36%) significantly reduces its diagnostic value.

A mathematical analysis of the CDC indicators showed an increase in the risk of malignancy in the presence of central and mixed types of blood flow in education. Thus, with avascular foci, thyroid cancer was found only in 2 (4.4%) cases; with peripheral blood flow in foci of prostate cancer, it was found only in 5 (11.1%) patients.

High numerical values of the Young's criterion indicate a significant change in the structure of tissues. It was found that the average values of the Young's criterion of 42.64±18.65 kPa are typical for benign nodular formations of the thyroid gland. The corresponding blue and green shades of

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the color pattern require clarification of the nature of proliferative changes, but are characteristic of nodular formations of a benign nature. The appearance of shades of red in the elastogram color pattern makes it possible to diagnose actively proliferating processes in the thyroid gland regardless of the size of the node. At the same time, the corresponding average values of the Young's criterion for the most suspicious areas of focal thyroid formations correspond to 196.45±24.23kPa. The elasticity indices of the focal formation of the thyroid gland, which are not included in the above ranges of values, are a transition zone, which in some cases complicates the differential diagnosis of proliferative changes in the focal formations of the thyroid gland when using ESW. This requires a detailed, in-depth analysis of the elastogram from the doctor in conjunction with other ultrasound and Doppler signs, and may also-

live as an indication to clarify the diagnosis by invasive techniques (TAPB). The detection of local zones in focal formations with average stiffness values of more than 40 kPa (average values of the Young's criterion) is an indication for repeated punctures and dynamic monitoring at least 2 times a year.

Conclusion

Thus, the diagnosis of focal thyroid pathology in B-mode does not differ in strict specificity and the presence of pathognomonic signs. The use of CDK in nodular pathology of the thyroid gland expands the diagnostic capabilities of the ultrasound doctor, however, like the B-method, it does not contribute to an unambiguous and rapid determination of the nature of the pathological process. The high diagnostic value of ESW in the differential diagnosis of thyroid cancer does not depend on the features of the ultrasound structure of the focal formation in the B-mode and with a high degree of probability may indicate the malignancy of the focal formation. ESW is a key step in the comprehensive ultrasound examination of the focal lesion of the thyroid gland and contributes to a more rational identification of areas for targeted TAPB. Only a comprehensive ultrasound examination of the focal formations of the thyroid gland, taking into account the informational significance of the parameters, makes it possible to optimize the tactics of managing these patients.

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