The Experience Of Using A Complex Of Modern Ultrasound Technologies In The Formation Of The Thyroid Gland

Khasan Khushnazarov, Yashnar Mamadalieva

Abstract: The article presents the results of a study of 156 patients with focal thyroid formations. Based on a comprehensive ultrasound study, the main specific diagnostic criteria for the formation of the thyroid gland in the early stages are determined. It was found that a modern comprehensive ultrasound study, including the gray scale mode, the entire spectrum of Doppler ultrasound and elastography, improves the quality of the study in the early detection of thyroid formations.

Index Terms: cancer, echostructure, elastograms, focal thyroid diseases, multiparameter ultrasound diagnostics, thyroid, ultrasound.

1 INTRODUCTION

Among modern medical and social problems, one of the most important is the thyroid gland (thyroid) disease, which is currently leading among the rest of the endocrine pathology. Moreover, the proportion of thyroid cancer (thyroid cancer) in relation to benign nodular and focal formations, according to the literature, ranges from 2 to 30% [1,5,10,19]. The prognosis of the disease in thyroid cancer largely depends on early diagnosis. The main difficulties in the timely comprehensive diagnosis of thyroid cancer are associated with the possibility of its long existence under the guise of or against the background of other thyroid diseases. Despite the significant achievements of radiation diagnostics, none of the methods of medical imaging can accurately distinguish benign thyroid pathology from malignant [11,17,19,25]. The introduction of the TI-RADS classification system into the practice of an ultrasound diagnostic specialist has reduced the total number of fine-needle aspiration puncture biopsy (TAPB) by 31.5%. The TI-RADS classification based on ultrasound data reflects the differentiation of nodular thyroid gland formation depending on cancer risk. TI-RADS allows you to standardize the protocol for ultrasound examination of the thyroid gland, to minimize the subjective factor in the interpretation of the ultrasound picture of the nodular formation of the thyroid gland; to develop a unified approach to interpreting the degree of alertness in thyroid gland formations of the thyroid gland. The use of TI-RADS contributes to a clear definition of indications for TAPB thyroid gland formation and surgical treatment, thereby reducing the number of unreasonable minimally invasive and surgical interventions on the thyroid gland [3,17]. Currently, research in B-mode, color and energy Doppler mapping is of the utmost importance in the ultrasound diagnosis of thyroid diseases. Differential diagnosis of thyroid disease is based on an assessment of the size of the gland, its echogenicity, echostructure and information about regional lymph nodes.

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Nodular formations in the gland are differentiated by localization, size, shape, boundaries, contours, echogenicity, internal echostructure, capsule state and gland vascularization [7,8,11,27]. According to numerous domestic and foreign publications, the sensitivity and specificity of the gray scale technique in the differential diagnosis of malignant and benign processes ranges from 55–70% [19,23]. The use of pulsed-wave Doppler ultrasonography, which makes it possible to evaluate blood flow in the nodes and thyroid gland, increases the sensitivity of the method slightly to 65–75% [7]. Modern ultrasound diagnostics, consisting of ultrasound imaging and Doppler ultrasound, was supplemented by a third technology - elastography. Shear wave elastography is a method that allows a quantitative assessment of tissue elasticity, which excludes the possibility of subjective interpretation of data [2,12,18,21,22]. Physically, a shear wave is an elastic transverse wave (ultrasonic wave - longitudinal), the displacement of the particles of the medium is perpendicular to the direction of the wave. The principle of operation of this technique is based on the generation of a shear wave in tissues caused by an ultrasonic pulse and the subsequent assessment of its progression speed. In this case, the visualization of the passage of the shear wave is also carried out by the ultrasonic sensor itself. The numerical values of the elasticity index are given in m / s or kPa, depending on the type of shear wave elastography, so the method is called “quantitative ultrasound elastography” or “elastometry”. It is reported in the literature that two methods are used for shear wave elastography: point and two-dimensional shear wave elastography [12,8,18,21,23,27,28]. Shear-wave spot elastography as a method for producing shear waves provides quantitative information on tissue elasticity, but only at a given depth in the focus area. To obtain shear waves at a different depth, it is necessary to shift the focus zone closer or further from the sensor and create the necessary pressure in the new powerful ultrasonic pulse to receive shear waves and measure their characteristics. The stiffness of the fabric is depicted in color: blue for softer, and red for stiffer. Following the study of color elastograms, elastometry is performed using one or more test volumes that are freely movable and resizable. Digital data can be presented either as indicators of shear wave velocity (in m / s) or elasticity (kPa). Thus, this technology allows you to quantitatively reflect the elasticity of the thyroid gland. A significant difference between this technology and the previous one (shear wave point

elastography) is that color mapping greatly facilitates elastometry, giving the doctor the opportunity to choose only high-quality, artifact-free elastograms [4,17,18,22]. Most of the works on the use of elastography are devoted to studies of the pathology of the mammary glands, prostate gland, and liver [6,8,9,12,21].

2 PURPOSE OF THE STUDY

Improving the differential and clarifying diagnosis of thyroid formations by applying a complex of modern ultrasound studies.

3 MATERIALS AND METHODS

Under observation were 156 patients sent for ultrasound to clarify the nature of focal formations in the thyroid gland. The age of patients ranged from 20 to 76 years. Among the examined patients, men and women were 48 (30.8%) and 108 (69.2%), respectively. The studies were performed on modern ultrasound devices Logiq S8 XD clear GE Healthcare (USA), HI VISION Preirus (Hitachi Medical Corporation, Japan), Samsung-Medison WS 80 AC ELITE (South Korea), MINDRAY DS-8 (China) and " MINDRAY DS-70 "(China), with a frequency range of the linear sensor 5-13 MHz. Ultrasound was performed according to the standard method with seroscale examination, color and energy Doppler mapping (CDK, EDK, spectral Doppler), and the elastography mode (compression and shear waves) was used, with which the stiffness of focal thyroid gland formations was assessed. To obtain high-quality compression ultrasound elastography (RTE), a linear sensor was mounted strictly perpendicular to the pathological formation of the mammary gland for 5-7 seconds. Elastograms were evaluated by a computerized color scale according to Itoh A.et al. [24], in which the degree of stiffness corresponds to a certain color: red and green are soft fabrics, blue are hard fabrics. Qualitative and quantitative changes in the structure of organ tissue under the influence of an ultrasonic signal during elastography are reflected in the form of a color scale and can be presented in the form of quantitative indicators. A qualitative criterion is an analysis of the distribution of the elasticity of breast tissue in color, and a quantitative one is the Strain Ratio, which assesses the degree of deformation of the formation of the mammary gland in comparison with the surrounding tissues [29].

4 RESEARCH RESULTS AND DISCUSSION

As a result of our studies, 66 (42.3%) of the examined had single thyroid nodules, and 90 (57.7%) showed multiple nodular formations. Thyroid lesions were observed in 58 (46.3%) women of reproductive age. In 52 (48.1%) patients, various variants of diffuse-nodular goiter were revealed. Of the 156 patients, uneven outlines of the formations were observed in 67 (42.9%) patients, uneven echogenicity in 62 (39.7%), the rim of the hull in 102 (65.4%), an increase in the thyroid gland in 116 (74 , 3%), calcifications in 59 (37.8.3%), hypervascularization in the CDK regimen in 134 (85.9%) patients. Thyroid tissue elasticity indices were above 163 kPa (normal 6.7-19.8 kPa) in 58 (37.2%) patients. When conducting elastography, the normative range was 18.4 ± 7.8 kPa. In benign formations, the arithmetic mean stiffness was 47.5 ± 10 kPa, which was significantly higher than normal ($p < 0.05$). Hypoechoic masses of 5–16 mm in size were characterized by uniform blue staining during elastography. When focal masses of mixed echogenicity larger than 16 mm were detected, as well as isoechogenic masses with a hypoechoic rim on the periphery, a cytological and histological examination determined a follicular adenoma without proliferation. During elastography, the formations had mosaic staining with a predominance of blue patches and several harder patches of green. On the elastograms, a mixed type of mapping was revealed with a predominance of rigid rigid sections of blue color. The arithmetic mean stiffness for malignant tumors was 169.2 ± 24.3 kPa, which was significantly higher than normal and significantly higher than the rigidity of benign tumors ($p < 0.01$).

***Fig. 1**. Normal thyroid tissue. Gray scale mode.*

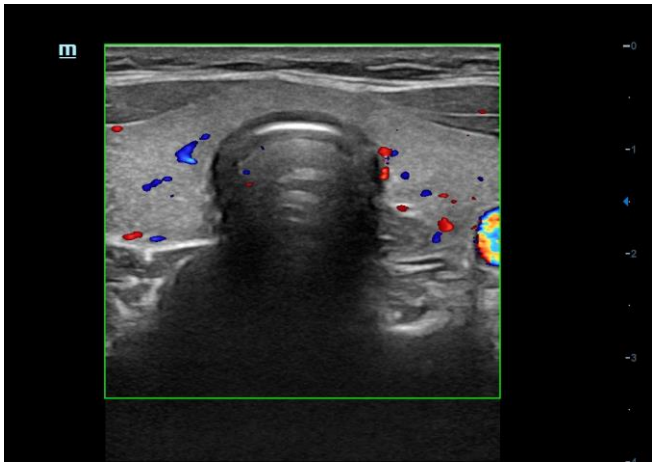

***Fig. 2**. Normal thyroid tissue in color Doppler mapping*

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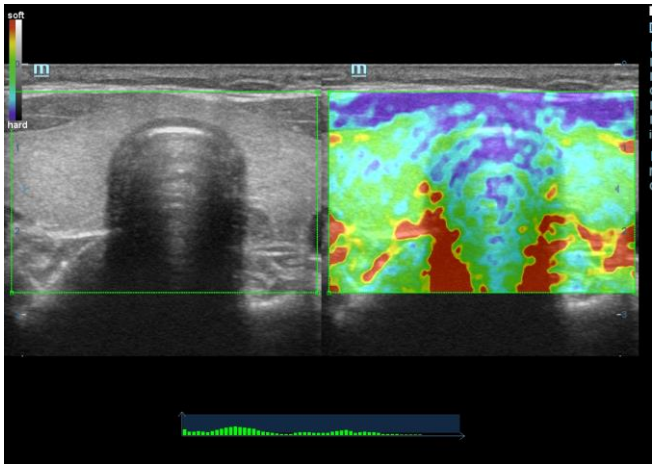

***Fig. 3**. Normal thyroid tissue in compression elastography mode.*

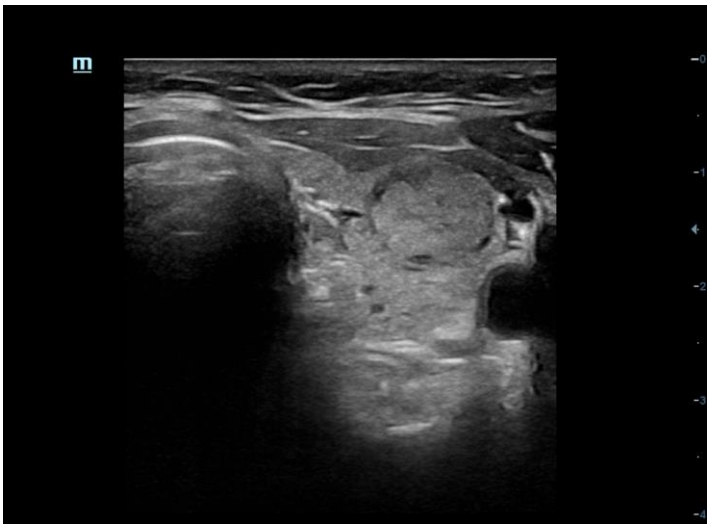

***Fig. 4**. Nodular formation of the thyroid gland. Gray scale mode.*

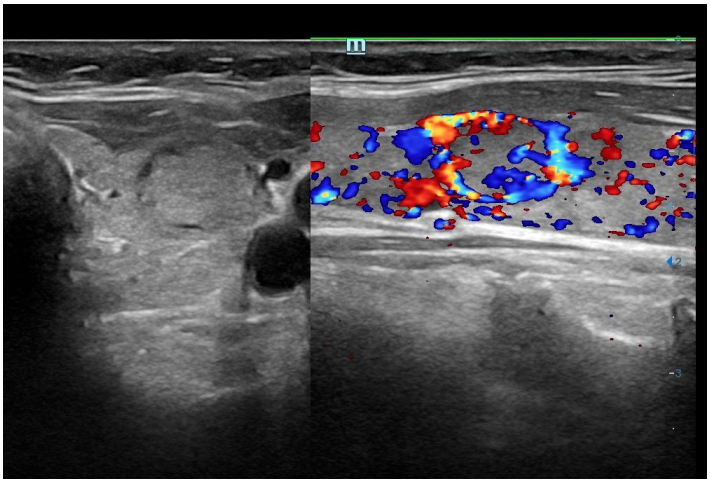

***Fig. 5**. Nodular formation of the thyroid gland. Peri-and intranodular hypervascularization of the node in the CDC mode.*

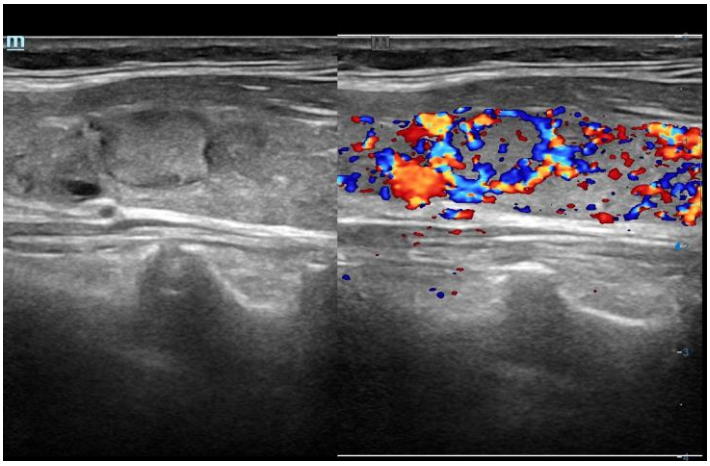

***Fig. 6**. Multiple thyroid nodules with enhanced peri-and intranodular vascularization in the CDK mode.*

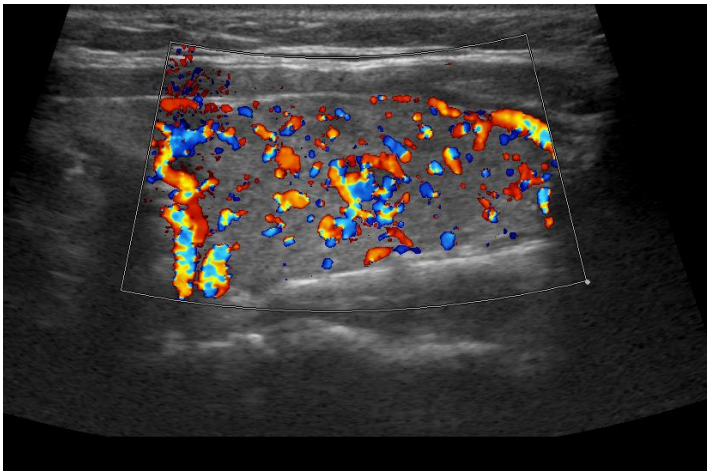

***Fig. 7**. Nodular thyroid gland formation with enhanced intranodular vascularization in the CDK mode.*

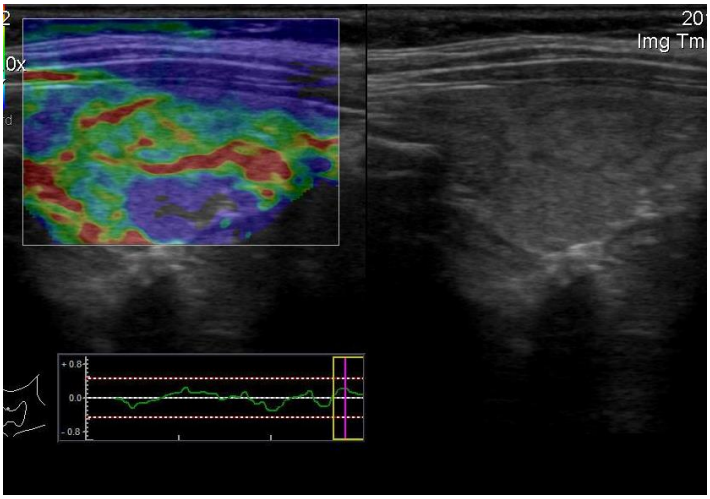

***Fig. 8**. Nodular thyroid gland formation in compression elastography mode.*

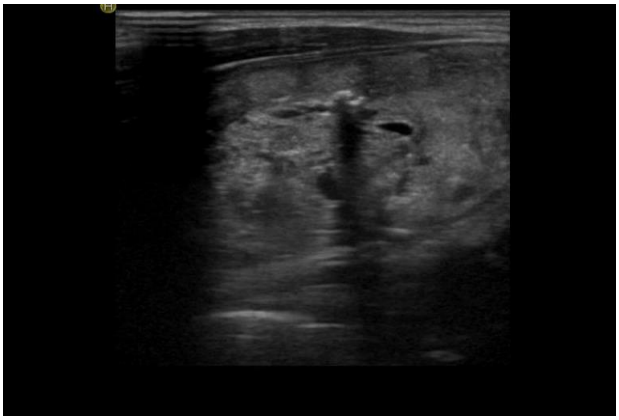

***Fig. 9**. Thyroid cancer in grayscale mode.*

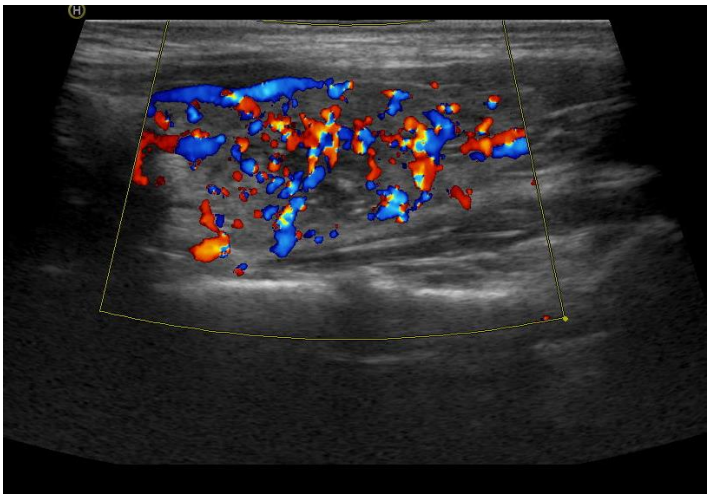

***Fig. 10**. Thyroid cancer with unevenly amplified chaotic vascularization in the CDK regimen.*

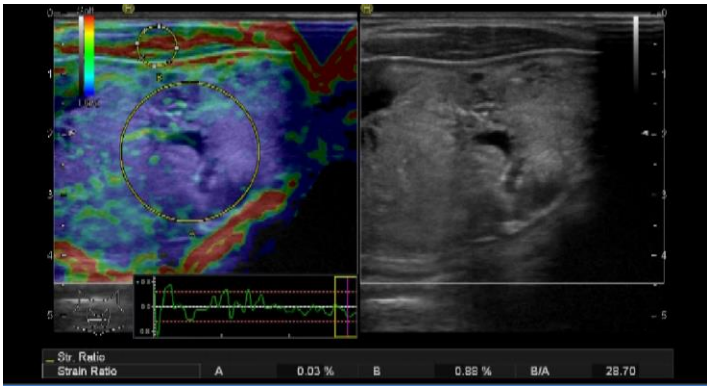

***Fig 11.** High stiff thyroid cancer in compression elastography (Strain Ratio 28.70).*

5 CONCLUSION

Thus, the use of a complex of modern ultrasound studies increases the information content of this method in the diagnosis of various thyroid formations. In a modern ultrasound study of focal thyroid diseases, the most informative ultrasound criterion was the unevenness of the contours, an increase in volume, the presence of calcifications, hypervascularization and a decrease in the elasticity of the affected tissue, and an increase in the stiffness index. Elastography is a key step in modern integrated ultrasound examination of focal thyroid lesions and contributes to a more rational definition of zones for TAPB. Only a modern complex ultrasound examination, including B-mode, EDC, CDK, spectral Doppler and elastography, taking into account the information significance of the parameters, helps to improve the quality of the study, early detection of focal thyroid formations and allows you to optimize the tactics of managing these patients. The diagnostic accuracy of the ultrasound method is improved to clarify the staging of focal formations of the thyroid gland, which allows to detect malignant tumors in the early stages. The sensitivity of modern ultrasound ultrasound in the diagnosis of focal thyroid lesions was 91.3%, specificity 79.9%, diagnostic accuracy 92.2%.

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