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On the issue of TI-RADS classification and stratification of signs of thyroid cancer

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In the world medical communities there is an active discussion of the TI-RADS system - a unified evaluation of thyroid nodules (TG). Various modifications of the system have been proposed,including national ones (French, Korean,American, British, etc.). Common to all variants of TI-RADS is an attempt to objectify the assessment of thyroid nodules for the detection of thyroid cancer and determination of more precise indications for puncture biopsy.The purpose of the study: a comparative “blind” assessment of thyroid nodules detected by ultrasound, according to TI-RADS scale in various modifications.

Material and methods. A “blind” retrospective analysis of 49 echograms of thyroid lesions was carried out three independent experts (experience Ultrasound of the thyroid gland for more than 2 years).

Results. In solid nodes, highly specific large (more than 94%) and small (more 90%) Ultrasound signs of thyroid cancer. Nodes stratified according to the TI-RADS system: 1 - in the modification of J.Y. Kwak et al. (2011), 2 - according to the system we proposed taking into account small ultrasound signs of thyroid cancer. High reproducibility indices of both systems were obtained. In the first system, 13.7% of cancer nodes fell into the TI-RADS category 3 (benign lesions),the second system, only 5% of cancers fell into the category

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TI-RADS 3, which is important for biopsy selection. The sensitivity of the first TI-RADS system was 82.05,the second system - 94.87%.

Conclusions. The TI-RADS classification can be used to interpret ultrasound results identified nodular formations of the thyroid gland, taking into account both the main large and small ultrasound signs of cancer. For its validation in our country needs to be carried out further extensive discussion of the proposed TI-RADS system.

Keywords: ultrasound,

TI-RADS, thyroid cancer.

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Introduction

To interpret the results of imaging instrumental research methods systems have been introduced in recent decades stratification of signs of malignancy of the identified focal pathology of various organs Imaging Reporting and Data System: BI-RADS(breast), TI-RADS (thyroid),PI-RADS (prostate), Lu-RADS (lungs), Li-RADS (liver), etc. All these systems are built on the example of the BI-RADS scale proposed by at the end of the last century by the American Society radiologists [1, 2], in which, as signs of goodness are lost and signs of malignancy increase, the formation is transferred to a higher category, where performance of a puncture biopsy. According to the category, recommendations are offered for further management of the patient [1–3]. This classification is very useful especially for interpreting the results of an ultrasound examination (ultrasound),

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since the method is the most subjective of all instrumental imaging diagnostics [3–5].In the late 90s of the last century, E.K. Kim andet al. 4 most significant ultrasound (US) signs of thyroid cancer identified(thyroid): the presence of microcalcifications, the predominance thickness of the node over the width (in ultrasound diagnostics, this corresponds to the term “vertical spatial orientation of the node” [6]), uneven contours and pronounced hypoechogenicity. Sensitivity this combination in the detection of thyroid carcinomas was 94% [7]. These features are used by many, including domestic, authors for the diagnosis of thyroid cancer [8–15].In 2009, E. Horvath et al. [16] the same signs were the basis for the TI-RADS classification,distributing the identified thyroid nodes according to the degree of risk of the presence of a malignant formation.If there are signs of malignancy, the nodes fell into categories 4 and 5. The authors proposed 10 echographic options for thyroid nodules,which were proposed to be used in clinical practice for risk stratification. The sensitivity and specificity of the proposed method were 88 and 49%, respectively [16].The possibility of conducting a unifiedassessment of thyroid nodules caused a liveresponse in professional communities around the he world. However, in the process of mastering the system TI-RADS turned out that working with the new classification is not so simple, the “analog” node assessment option is not very convenient and does not cover all

Subsequently, other researchers, including

number of domestic ones, various according to the number and ranking of ultrasound signs of malignancy of solid nodules [17–21], which was applied in several modifications of TI-RADS [22–27]. In some classifications, it is proposed to evaluate the nodes according to a scoring system [25, 28].Some countries have

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proposed their own “national” options for the stratification of thyroid nodules.[28-31], using a different number of TI-RADS 4 subcategories with different approaches to inclusion in the lymph node assessment system. Common to of all TI-RADS variants are an attempt to objectify the assessment of thyroid nodes to identify thyroid cancer and determination of more accurate indications for punch biopsy.In our country, a number of clinics have begun to use the TI-RADS classification in modification J.Y. Kwak et al. (2011) [23] with estimate malignant . Feasibility according to 5 features. However, it is well known that thyroid cancer has many manifestations and can be disguised as various options benign formations where these basic features are not present. In 2016, we allocated except for the 5 main highly specific features cancer, there are still additional signs (we designated them as small), which have either enough high specificity (90–97%) with low sensitivity (11–30%) or high sensitivity (>90%) with low specificity (<40%), which does not allow them to be completely excluded from the differential diagnostic process when assessing thyroid nodules (Table 1) [6].So far, these symptoms were not taken into account in the existing classifications. We have made an attempt to include them in the system TI-RADS, so that on this basis from the category TI-RADS 3 classify a number of seemingly benign lesions in the TI-RADS category 4a for puncture. Purpose of the study comparative “blind” assessment of thyroid nodules according to the TI-RADS scale in various modifications.

Material and methods

A “blind” retrospective analysis was carried out 49 echograms of formations by three independent experts (the experience of performing ultrasound of the thyroid

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gland is more than 2 years). The tasks of experts in the analysis of echograms included:

• evaluate each node by the presence of 5 explicit(large) and 4 small ultrasound signs of cancer (see.tab. one);

• identify each node in accordance with the selected features in two options at once TI-RADS scales.

First option. TI-RADS by J.Y. Kwak

et al. (2011) [23] taking into account only 5 large signs of cancer: masses without signs of cancer from Table 1. Indicators of diagnostic informative value of ultrasound signs of thyroid cancer

(B-mode)

Ultrasound sign	Informative indicators			
	sensitivity, %	specificity, %	PCPT, %	PCOT, %
Fuzzy boundaries The contours are uneven, bumpy,macro/microlobular	77,8 72,2	94,7 94,9	87,5 86,7	90,0 88,1
Spatial orientation: vertical indefinite (spherical) shape	61,1	100,0	100,0	84,8
Significantly reduced echogenicity: Hyperechoic	27.8	97.4	83.3	74.5

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microinclusions: microcalcifications and psammoma bodies Macrocalcifications				
Dorsal attenuation of the ultrasound signal	16.7	97.4	75.0	71.7
Heterogeneous structure	94.4	36.8	48.5	91.3

Note. PTPV – positive test predictive value, PTTC – predictive value negative test.

TI-RADS 1. No focal changes in the thyroid parenchyma.

TI-RADS 2. Focal masses that do not require morphological evaluation (macrofollicles; spongy or cystic nodules) shown in Fig. one.

TI-RADS 3. Focal structures that require dynamic observation without performing a biopsy (hyper- or isoechogenic formations with even contours, including against the background of autoimmune thyroiditis; calcified nodules of the “eggshell” type) (Fig. 2).

A puncture in the TI-RADS 3 category is possible at the insistence of the patient or if there is a clinical need on the recommendation of the attending physician.

With negative dynamics in the process of dynamic monitoring, it is assumed that 4 nodes will be transferred to the TI-RADS category, which significantly changed their characteristics in B-mode over 6–12 months of observation:

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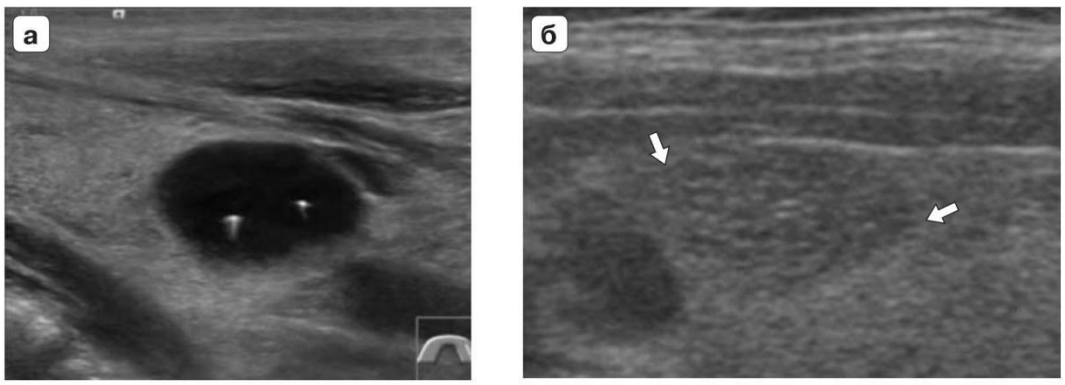
– the size of the node has increased (the volume has increased by more than 30%);

- nodes acquired a spherical shape, calcifications appeared, deformation of the node capsule (and / or thyroid capsule);

- Pathologically altered lymph nodes of the neck appeared, which were not detected earlier.

All hypoechoic nodules are proposed to be classified in categories 4 and 5.



pic. 1. Category TI-RADS 2: a – cystically dilated or macrofollicle; b - spongy knot (arrows).

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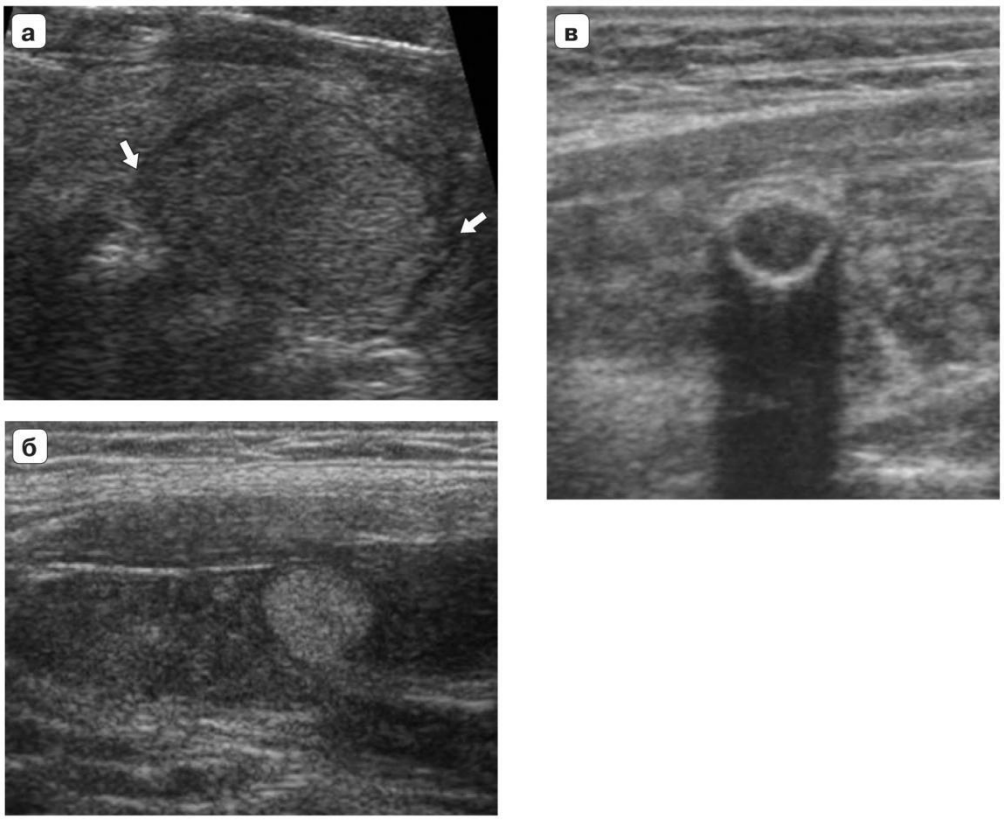


pic. 2. Category TI-RADS 3: a – isoechoic focus (arrows) surrounded by a thin halo (nodular goiter); b - hyperechoic focus of rounded shape, with clear contours, thin hypoechoic rim against the background of autoimmune thyroiditis; (c) a calcified nodule of the “eggshell” type.

TI-RADS 4. Nodules larger than 1.0 cm in diameter with “small” signs of malignancy for PUNCTION (Fig. 3):

solid nodes, uniformly or unevenly moderately reduced echogenicity;

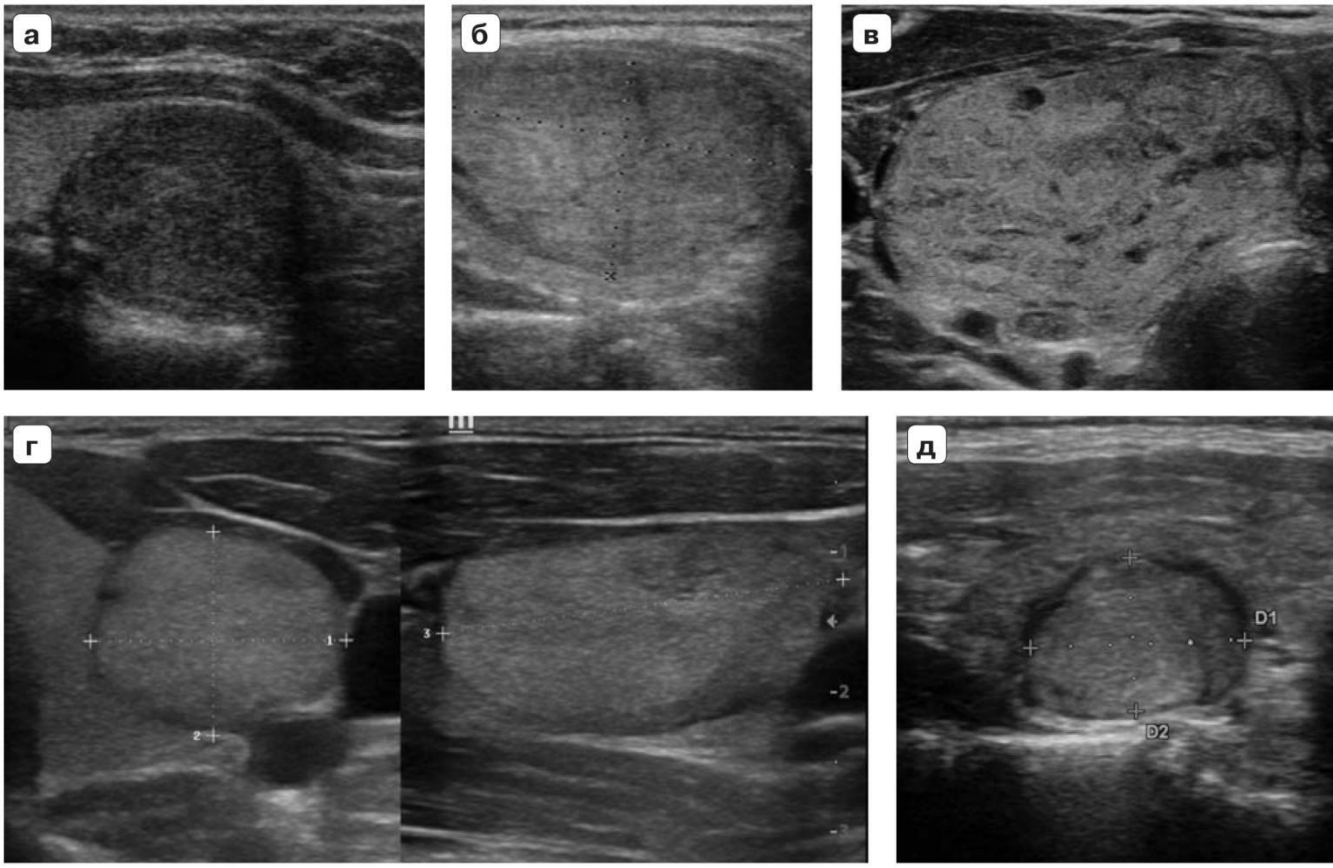
solid nodes iso- or hyperechoic, having "small" signs of malignancy:

- hypoechoic inclusions;

- rounded / spherical shape;

- unevenly thickened halo;

- macrocalcifications.



pic. 3. TI-RADS 4: a – a spherical nodule, with even and clear contours, moderately reduced echogenicity, with areas of lower echo, with macrocalcification. The node is surrounded by a thin halo (follicular neoplasia); b,

c, d (transverse and longitudinal scanning of the left lobe of the thyroid gland) - isoechoic nodes with hypoechoic inclusions, with clear contours, with a thin halo (follicular adenoma); e - isoechoic node with hypoechoic inclusions, with unevenly thickened halo (follicular cancer).

TI-RADS 5. Solid nodules with “large” signs of malignancy for PUNCTION:

solid nodules more than 1.0 cm in diameter: in the presence of at least one “large” sign of malignancy (Fig. 4):

– Significantly reduced echogenicity;

– vertical spatial orientation of education;

- uneven contour of education: hilly, microlobulated, radiant;

- the presence of microcalcifications in the tumor;

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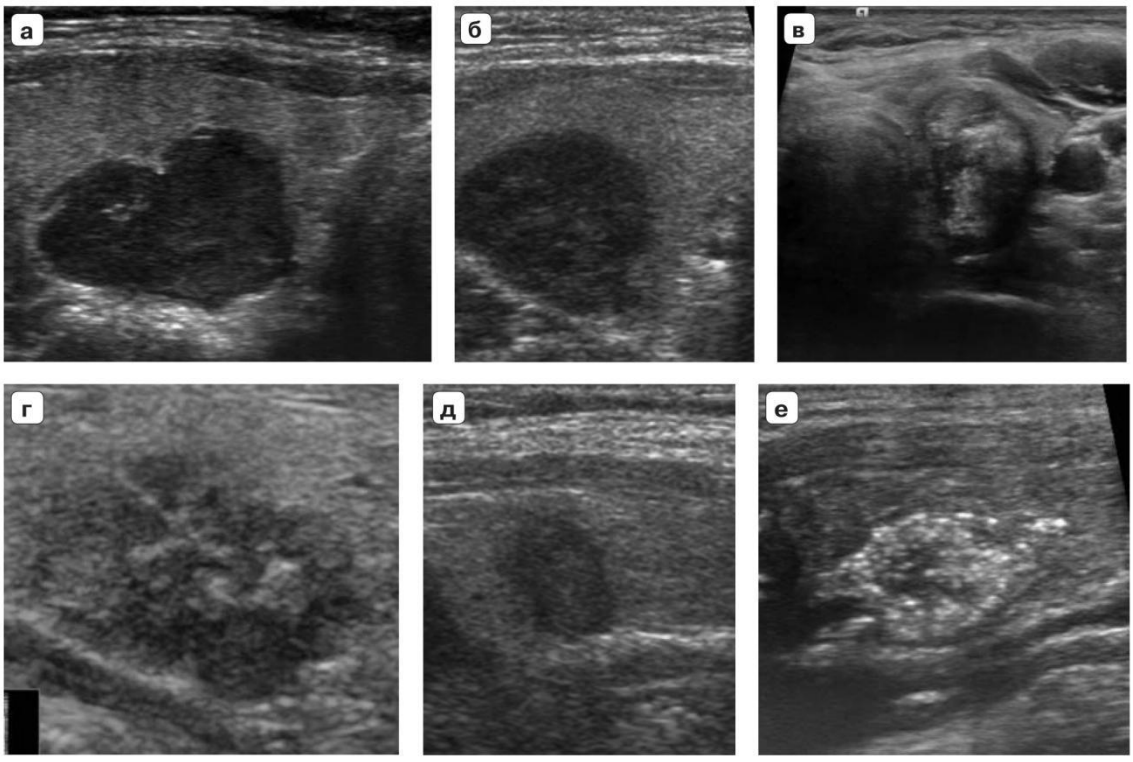
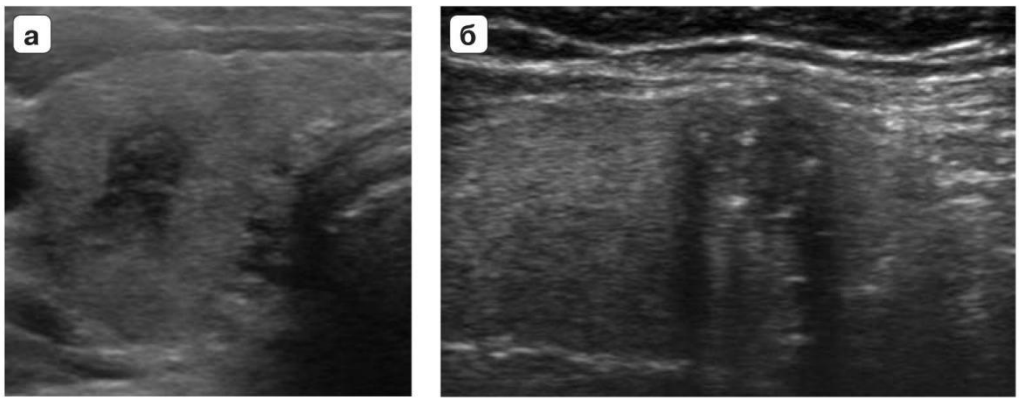


pic. 4. TI-RADS 5. Nodes of the thyroid gland >1.0 cm in size (papillary cancers): a, b - nodes of significantly reduced echogenicity with microcalcifications, with uneven microlobular contours; c - node of vertical spatial orientation, with fuzzy, uneven contours, significantly reduced echogenicity, with multiple microcalcifications; d - a node with microlobulated fuzzy contours, unevenly reduced echogenicity, with microcalcifications; e - a node of significantly reduced echogenicity, vertical spatial orientation, with fuzzy, uneven (radiant) contours; f – node with fuzzy contours, with multiple microcalcifications.

solid nodules less than 1.0 cm in diameter: if there are at least two “large” signs of malignancy (Fig. 5) listed above.



pic. 5. TI-RADS 5. Nodes of the thyroid gland <1.0 cm in size: a - a node with fuzzy and uneven radiant contours, vertical spatial orientation, significantly reduced echogenicity, with microcalcifications; b - a node of spherical shape, with fuzzy, blurred, uneven microlobular contours, moderately reduced echogenicity, with microcalcifications, grows up to the thyroid capsule, deforming the outer contour of the lobe. Cytologically and histologically, papillary cancer was diagnosed in all presented nodes.

In the presence of altered lymph nodes (spherical shape, disappearance of differentiation of internal structures, cystic changes, calcifications), it is advisable to add “LYMPHADENOPATHY” to the TI-RADS category in the conclusion. Based on the conclusion of the ultrasound examination and clinical and laboratory data, the endocrinologist makes the final decision on the need to perform a puncture biopsy of the thyroid node and altered lymph nodes of the neck.

The presented version of the TI-RADS modification is closest to the European version [1]. For work in the conditions of our country, TI-RADS options seem to be less acceptable, offering the assignment of points to each ultrasound feature,

with further distribution of nodes into TI-RADS categories depending on the amount of points [2, 9].

A group of authors conducted a pilot study to assess the reproducibility of the European version of the TI-RADS system and the version proposed by a group of domestic authors, with using the Cochrane criterion [26]. The proportion of results coincidence (when different researchers attributed the same node to the same category) was 79%, the Cochrane coefficient was 03–05 ($p < 0.001$), which indicates a good reproducibility of this method for assessing the malignant potential of thyroid nodules by different operators.

Both TI-RADS variants had the same specificity of 93%. The domestic version slightly exceeded the European one in terms of sensitivity: 94.2 vs. 91.0%, respectively, which can be explained by taking into account a larger number of “small” signs of malignancy. It seems important to us to pay attention to these signs. A number of studies have shown that in 13.4% of cases in the cancerous nodes of the thyroid gland it is not possible to detect a single "big" sign of malignancy; in 10.1% of cases, only one “big” sign of cancer is detected; in 25.6% of cases, a combination of one “big” sign with several “small” signs is determined; in 13% of cases, only “small” signs of malignancy can be differentiated [21, 27].

“Small” signs often occur in nodes approaching 2.0 cm in diameter [21]. Currently, we operate with node sizes up to 1.0 cm and over 1.0 cm, according to a number of Russian clinical guidelines [11, 28]. In the latest Western versions of TI-RADS,

the size of the nodes is divided from 0.5; 1.0; 1.5; 2.0 cm or more [1, 2]. Perhaps we should also consider these modifications.

CONCLUSION

We propose that a broad discussion be held on the proposed TI-RADS classification for its further optimization and acceptable standardization in the foreseeable future. Our approach is due to the desire to bring together the positions of domestic specialists in ultrasound diagnostics and Russian endocrinologists. The transition to a single information diagnostic platform for these two specialties, we hope, will have a positive effect on the final indicators of the results of managing patients with nodular tumors of the thyroid gland.

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