

EFSUMB Guidelines on Multiparametric Ultrasound Thyroid Nodule Evaluation: PART I

EFSUMB-Leitlinien zum multiparametrischen Ultraschall von Schilddrüsenknoten: TEIL I

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ABSTRACT

Thyroid nodules are common incidental findings, but only a small proportion of cases are malignant (4–6.5 %) or symptomatic. Numerous follow-up examinations and invasive diagnostic procedures, such as fine-needle aspiration, fine-needle

biopsies, and thyroidectomies, are performed, leading to potentially costly and time-consuming diagnostic procedures and overtreatment. Most experts and scientific societies (EFSUMB, WFUMB, etc.) encourage the use of multiparametric ultrasound evaluation (MPUS) to improve thyroid nodule characterization due to the continuous technological developments including new ultrasound software (microvascular flow imaging, elastosonography, etc.), contrast media (CEUS), and artificial intelligence (AI). Therefore, the recognition and proper use of new multiparametric ultrasound features of thyroid nodules are essential for minimizing unnecessary interventions and guiding appropriate treatment. The goal of these guidelines is to help initiate use of these features in routine clinical practice. In addition, we analyze the use of MPUS in some emblematic thyroid scenarios, such as cytologically indeterminate nodules, multinodular goiters, and extrathyroidal extension of the malignant nodule, and the usefulness of MPUS as a guide for thyroid biopsy/aspiration and in the staging of cervical lymph nodes. Recommendations based on the level of evidence of the published literature and on the EFSUMB expert group's consensus are given for each question.

ZUSAMMENFASSUNG

Schilddrüsenknoten sind häufige Zufallsbefunde, aber nur ein kleiner Teil der Fälle ist maligne (4–6,5%) oder symptomatisch. Zahlreiche Folgeuntersuchungen und invasive diagnos-

tische Verfahren wie Feinnadelaspiration, Feinnadelbiopsien und Thyreoidektomien werden durchgeführt, was zu potenziell kostspieligen und zeitaufwendigen Abläufen und zur Übertherapie führen kann. Die meisten Experten und Fachgesellschaften (EFSUMB, WFUMB usw.) empfehlen die Verwendung des multiparametrischen Ultraschalls (MPUS) zur Verbesserung der Charakterisierung von Schilddrüsenknoten. Dies ist auf die kontinuierlichen technologischen Entwicklungen zurückzuführen, darunter neue Ultraschallsoftware (Mikrovaskuläre Flussdarstellung, Elastosonografie usw.), kontrastmittelverstärkter Ultraschall (CEUS) und Künstliche Intelligenz (KI). Daher ist die Erkennung und korrekte Beurteilung neuer multiparametrischer Ultraschallbefunde von Schilddrüsenknoten unerlässlich, um unnötige Eingriffe zu minimieren und eine adäquate Behandlung zu gewährleisten. Ziel dieser Leitlinien ist es, die Anwendung dieser Methoden in der klinischen Routinepraxis zu unterstützen. Darüber hinaus analysieren wir den Einsatz von MPUS in einigen typischen Schilddrüsenfällen, wie z. B. zytologisch unklaren Knoten, multinodulären Strumen und extrathyroidaler Ausdehnung maligner Knoten, sowie den Nutzen des MPUS als Unterstützung der Schilddrüsenbiopsie/Aspiration und für das Staging zervikaler Lymphknoten. Für jede Fragestellung werden Empfehlungen auf Grundlage der Evidenz der veröffentlichten Literatur und des Konsenses der EFSUMB-Expertengruppe gegeben.

Introduction

Thyroid nodules (or focal thyroid lesions) are highly prevalent. The detection rate by palpation in the general population is 3% to 7%, while the detection rate by ultrasound is 20% to 76% [1]. Most thyroid nodules are asymptomatic and are detected incidentally on imaging exams performed for other indications. Only a small proportion of cases are malignant (4–6.5%) or symptomatic and their prevalence increases with age [2, 3]. Furthermore, the incidence of thyroid cancer may be even lower in the different populations analyzed, with the incidence of thyroid nodules varying based on various factors, such as iodine deficiency. Indeed, a recent study conducted in Germany demonstrated a rate of thyroid malignancy much lower than expected, approximately 1% [4]. Thus, follow-up examinations are likely to lead to potentially time-consuming and costly diagnostic procedures, overdiagnosis, and thus overtreatment [5].

Diagnostic ultrasound imaging is the main modality for the initial assessment and long-term follow-up of thyroid nodules owing to its high resolution and ease of access [6].

Clinical practice guidelines on CEUS and elastography have been published by the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) and the World Federation for Ultrasound in Medicine and Biology (WFUMB). These guidelines have improved our understanding of these techniques

and provided an internationally standardized practical approach to their use [7, 8, 9, 10, 11, 12, 13].

Recent consensus statements generally recommend combined use of ultrasound features to identify thyroid nodules for risk stratification and further workup, with the main aim being to reduce the number of unnecessary invasive procedures, treatments, and follow-up studies. This combined approach will be described in these EFSUMB guidelines on multiparametric ultrasound.

Detection and characterization of thyroid nodules Conventional US findings

PICO 1: TIRADS – What is the role of TIRADS?

Ultrasound (US) is recognized as being pivotal for managing patients with thyroid nodule(s) owing to the significant experience reported over last 2 decades. The use of single US features (echogenicity, margins, shape, calcification, etc.) has been proven to be limited by inter- and intra-observer agreement [11]. Hence multiple US risk stratification systems using a combination of ultrasound features have been developed by international societies focused on thyroid disease starting from the initial experience published in 2009 by Chilean authors [6]. The objective of stratification systems, generally labeled as TIRADS is to provide recommendations to stratify the risk of malignancy in thyroid nodules.

In addition, TIRADS systems were conceived to define a standard lexicon for describing thyroid lesions and delineate suspicious US characteristics. Some differences exist between these systems. The number of categories range from 3 to 6. Some of these are based on identification of the nodule's sonographic pattern [14, 15, 16, 17, 18], while the American College of Radiology (ACR TIRADS) [19] is a point-based scoring system. Several studies have evaluated the performance of various TIRADS systems, sometimes comparing them, based on 2 endpoints, such as accuracy with respect to detecting thyroid cancer and reliability with regard to indicating the lowest number of "non-necessary" fine needle aspirate cytology procedures (FNAC i.e., those with benign cytology). Even if the overall results are reassuring for clinical operators, the clinical use and feasibility of TIRADS systems need to be considered [20]. Implementation of TIRADS remains a challenge but can be supported by standardized reporting templates, education of users, and use reminders at the point of care [21].

1A: Which TIRADS system has the best accuracy for thyroid cancer detection and nodule characterization?

A few systematic reviews [22, 23, 24, 25, 26, 27, 28] have been published on this topic and these provide the evidence-based data on TIRADS accuracy with regard to detecting thyroid nodules with a high risk of malignancy. The first review by Wei et al. [22] included 5 studies with 7,753 nodules and described a sensitivity and specificity of 0.75 (95% confidence interval 0.72–0.78) and 0.69 (95% confidence interval 0.68–0.70), respectively. In their meta-analysis, Castellana et al. [23] included 12 studies with 18,750 thyroid nodules subjected to either FNA, core-needle biopsy, or surgery. The results showed that the performance of TIRADS was quite similar to that of the 5 most used systems. Furthermore, the analysis of the diagnostic odds ratio (DOR) in this study showed higher performance of ACR-TIRADS versus the ATA (American Thyroid Association) guidelines ($p=0.002$) or K-TIRADS (Korean Society of Thyroid Radiology) ($p=0.002$). Another meta-analysis by Kim et al. [24] did not find any significant difference between ACR-TIRADS, EU-TIRADS, and K-TIRADS, but there was a trend towards a higher sensitivity with EU-TIRADS (78% [95% confidence interval, 64–88%] and higher specificity with K-TIRADS (93% [91–95%]). In their meta-analysis [25], Li et al. focused on ACR-TIRADS only and found a pooled sensitivity and specificity of 0.89 (95% CI, 0.81–0.93) and 0.70 (95% CI, 0.60–0.78), respectively. The latest meta-analysis by Bian et al. [26] compared various TIRADS systems with computer-aided technology and found quite similar sensitivities 0.89 vs. 0.85, respectively. Two other systematic reviews by Migda *et al.* and Staibano *et al.* were aimed at evaluating the performance of TIRADS with regard to predicting malignancy in nodules with indeterminate FNA and found discordant results with poor specificity [27, 28].

The discrepancies in the diagnostic performance of different TIRADS systems arise from their performance in outlier nodules – some malignant nodules do not have sufficient US features to indicate malignancy and some benign nodules have US features suggesting malignancy. K-TIRADS and ACR-TIRADS had better diagnostic efficiency with regard to differentiating nodules >10mm, but they cannot simultaneously achieve high sensitivity

and high specificity. ACR-TIRADS improves sensitivity in combination with K-TIRADS (from 81.4% to 89.2%), whereas C-TIRADS increases specificity in combination with EU-TIRADS (from 80.9% to 85.7%). A recent study group suggested combining various TIRADS evaluations [29], and if the diagnostic findings of 2 TIRADS systems are inconsistent, greyscale nodule characteristics are prioritized in the differentiation of benign and malignant nodules with an accuracy of 79.0%. In any case, the discrepancies among the results from meta-analyses could be due to the various sizes of the included populations [30].

Autonomously functioning thyroid nodules (AFTNs) are virtually always benign but represent a potential limitation to the accuracy of TIRADS systems. In fact, AFTNs cannot be differentiated from non-functioning follicular adenomas/carcinomas by fine-needle aspiration (FNA) or US/TIRADS. As AFTNs often present with large dimensions and their US presentation is heterogeneous, TIRADS systems tend to assess them for FNA [31]. Clinical features should always be taken into account to avoid unnecessary FNA procedures [32].

No consensus on the best system has been reached yet, although the capability of combinations with a preference for ACR-TIRADS and K-TIRADS for sensitivity and EU-TIRADS and C-TIRADS for specificity appear promising (► **Table 1**).

RECOMMENDATION:

- A TIRADS system should be used for the assessment of malignancy risk, characterization, and follow-up of thyroid nodules. The report should state the particular TIRADS system used, and the same TIRADS system should be applied for follow-up. LoE 1a, strong recommendation (For: 20; Abstain: 0, Against: 0)

PICO 1B: Which TIRADS should be used to reduce unnecessary FNAC procedures?

Several original studies have evaluated the efficacy of TIRADS with regard to reducing unnecessary FNAC procedures. In this context, there is one notable systematic meta-analysis by Kim et al. [33]. This study included 8 series with a total of 13,092 nodules classified according to either ATA or ACR-TIRADS, EU-TIRADS, or K-TIRADS systems. The results showed that the rates of unnecessary FNA procedures were as follows: ATA 51% (95% CI, 44–58%), ACR-TIRADS 25% (95% CI, 22–29%), EU-TIRADS 38% (95% CI, 16–66%), and K-TIRADS 55% (95% CI, 42–67%) with significant differences between ACR-TIRADS versus ATA and K-TIRADS. It has to be taken into account that almost all original papers evaluate the performance of risk stratification systems/TIRADS, almost exclusively for papillary thyroid cancer. The prevalence of papillary thyroid carcinoma in large studies evaluating the diagnostic performance of TIRADS systems was 95%, whereas follicular thyroid carcinoma, medullary thyroid carcinoma, and other malignancies accounted for only 2%, 2%, and 1% of cases, respectively [34]. TIRADS reliability with respect to detecting these rarer types of thyroid cancer is significantly lower compared to papillary thyroid carcinoma [35], with medullary thyroid carcinoma being assigned to a high-risk/suspicion category in only 54.8% of cases in one meta-analysis, for example [36] (► **Table 1**).

► **Table 1** Number of documents identified, selected, and included for each PICO question analysis.

2025 Thyroid MPUS Guidelines PICO	Identification		Screening				Included	
	Records identified from databases (PubMed, Embase)	Records identified from other sources	Total records before screening	Total after duplicate records removed	Records assessed for eligibility	Excluded records	Included records	Excluded records
PICO 1: TIRADS What is the role of TIRADS?								
PICO 1A: Which TIRADS system has the best accuracy for thyroid cancer detection and nodule characterization?	356	0	356	276	16	260	8	8
PICO 1B: Which TIRADS should be used to reduce unnecessary FNAC?	281	0	281	236	21	215	4	17
PICO 2: COLOR DOPPLER What is the role of color Doppler techniques in the characterization of thyroid nodules? Should color Doppler techniques be used to improve TIRADS characterization of thyroid nodules?	1495	0	1495	1040	188	852	13	175
PICO 3: US ELASTOGRAPHY What is the role of ultrasound elastography (USE)? Does ultrasound elastography improve TIRADS characterization of focal thyroid lesions? Which is the best ultrasound elastography technique?	944	0	944	653	113	520	28	105
PICO 4: CEUS What is the role of contrast-enhanced ultrasound (CEUS)? Which CEUS method (qualitative; quantitative) should be preferred for the characterization of thyroid nodules? Does CEUS improve the detection/diagnosis of cancer and characterization of nodules compared to TIRADS for the characterization of thyroid nodules?	36	0	36	36	27	9	20	7

RECOMMENDATION:

- ACR-TIRADS should be used to reduce unnecessary FNAC procedures to rule out thyroid carcinoma, especially the papillary type. LoE 2a, strong recommendation (20: For, 0: Abstain, 0: Against)

PICO 2: Doppler technique findings

- *What is the role of color Doppler techniques in the characterization of thyroid nodules?*
- *Should color Doppler techniques be used to improve TIRADS characterization of thyroid nodules?*

Color Doppler ultrasound (CDUS) and other Doppler techniques allow the identification of blood flow within thyroid tissue and focal lesions. They are widely used to assist in the diagnosis of thyroid nodules, metastatic cervical lymph nodes in patients with thyroid cancer, and thyroiditis, as well as for the monitoring of thyroid interventions [37]. In older studies, peripheral vascularization of a thyroid nodule was supposed to be a sign of benignity, in contrast to intranodular vascularization as a sign of malignancy [38]. In addition, 2 meta-analyses [39, 40] have demonstrated that primarily intranodular vascularization – with or without perinodular vascularization – raised the likelihood of malignancy, whereas solely perinodular vascularization was considered a sign of benignity. However, more recent studies could not confirm these results [40, 41]. This is possibly due to differences in equipment and examiner-related aspects as well as device settings (particularly, the pulse repetition frequency [PRF]). The diagnostic benefit of vascularization analysis using CDUS for predicting malignancy, therefore, remains controversial, and recent guidelines do not recommend its routine use for malignancy risk stratification of thyroid nodules [14]. However, CDUS may be useful for differentiating nodules or nodular components, where vascularization is diminished or absent (e.g., thick colloid, cystic or necrotic nodules). Therefore, CDUS indirectly supports risk stratification and is useful for guiding FNA and minimally invasive procedures in mixed thyroid lesions [42].

Microvascular flow imaging (MVFI) efficiently separates low-velocity blood flow signals from noise so that the presence of slow-flow vessels and their distribution can be outlined with greater resolution compared to CDUS, and without the need for contrast agents [43, 44, 45, 46]. A recent meta-analysis concluded that the diagnostic efficiency of this technology for malignant thyroid nodules is superior to CDUS [47], and combining MVFI with TIRADS significantly differentiated benign from malignant thyroid nodules compared with TIRADS alone [48]. However, these results are not sufficiently valid to justify a general recommendation owing to the origin of data almost exclusively from one country, the small number of cases in exclusively retrospective studies, the limitation of the use of only one specific MVFI product, the insufficient number of nodules ≤ 10 mm, and other methodological flaws (► Table 1).

RECOMMENDATIONS:

- Color Doppler techniques should be used as part of multiparametric ultrasound to evaluate vascularity of thyroid nodules. LoE 2a, strong recommendation (For: 20, Abstain: 0, Against: 0)
- Color Doppler techniques should not be used for stratification of malignancy risk. LoE 2a, strong recommendation (For: 20, Abstain: 0, Against: 0)

Non-conventional US findings

PICO 3: What is the role of ultrasound elastography (USE)?

- *Does ultrasound elastography improve TIRADS characterization of focal thyroid lesions?*
- *Which is the best ultrasound elastography technique?*

Semi-quantitative strain ultrasound elastography (USE) in a TIRADS system can improve the sensitivity of B-mode US TIRADS criteria and reduce the number of unnecessary FNAC procedures [49]. A large meta-analysis including 72 studies and 14,015 thyroid nodules highlighted the diagnostic value of USE, showing pooled sensitivities, specificities, and AUC of 84 %, 81 %, and 0.89, respectively, for qualitative US elastography, 83 %, 80 %, and 0.93, respectively, for semi-quantitative USE, and somewhat lower diagnostic performance for quantitative USE with a pooled sensitivity of 78 %, specificity of 81 %, and AUC of 0.87 [50]. However, the included studies were predominantly retrospective, and the high overall cancer prevalence of 33 % suggests a selection bias in some centers. Furthermore, there were significant differences in the included studies with regard to the specific techniques used for USE, the cut-off values, and the reference standards.

Multiple articles comparing qualitative and semi-quantitative USE techniques have been published. The related meta-analyses concluded that, although qualitative strain elastography (SE) techniques are effective in the characterization of thyroid nodules [51, 52], strain ratio elastography (SRE) was more accurate [53, 54, 55]. A meta-analysis by Tian et al. [55] yielded better accuracy values for SRE when compared to qualitative USE, with sensitivities and specificities of 86.5 % vs. 81.8 % and 86.6 % vs. 81.7 %, respectively. After the introduction of shear wave elastography (SWE), recent studies demonstrated that SWE techniques were also helpful in differentiating malignant nodules from benign ones [56, 57, 58, 59]. Further studies comparing SE techniques to SWE techniques for thyroid nodule characterization reported that SE techniques had higher sensitivity, with similar or slightly higher specificity rates [55, 59]. Furthermore, a recent meta-analysis including 72 studies between 2011 and 2021, comparing the qualitative SE, semiquantitative SE (namely, SRE), and SWE techniques, concluded that SRE performed a little better than qualitative SE and SWE with area under the curve (AUC) values of 0.93, 0.89 and 0.87, respectively [49].

SE (strain elastography): No consensus has been reached about the cut-off values to use for the strain ratio (SR). Values as low as 1.5 have been suggested for benign nodules and as high as 5 for malignant nodules. It has also been shown that the SR has lower

interobserver variability and is easier to learn than simple color pattern recognition [11].

SWE (shear wave elastography): Currently there is no consensus regarding the stiffness value ranges to be used for distinguishing benign from malignant thyroid nodules as these values differ between different ultrasound manufacturers.

A recent meta-analysis [60] that included 14 studies and 2,851 thyroid nodules suggested cut-off values ranging from 26.6 to 85.2 kPa. It concluded that 2D-SWE had a high diagnostic accuracy although the sensitivity and specificity were average.

Studies using point shear wave elastography (pSWE) [61, 62, 63, 64, 65, 66] indicated a mean SWE velocity for malignant nodules of 3.13–3.9 m/s with a cut-off value of 2.15–3.77 m/s. Interestingly, a recent meta-analysis [59] showed that SE and SWE were not significantly different in terms of sensitivity (SWE pooled sensitivity = 79% [95% CI 73–84%]) but that SE was superior to SWE in terms of specificity (SWE pooled specificity = 87% [95% CI 79–92%]) and accuracy (SWE pooled accuracy = 83% [95% CI 80–86%]).

Many studies have been published to present data comparing the diagnostic performance of different TIRADS systems to that of various USE techniques. Owing to the variability of terminology in TIRADS systems and the different sonoelastographic techniques, it is exceptionally difficult to perform a meta-analysis of these studies. On the other hand, although varying results have been reported in terms of relative accuracy of one system over the other, the most common conclusion reached in many of these publications is the apparent superiority of combined use of USE techniques with TIRADS systems rather than using them in isolation. This was one of the recommendations of Russ et al. in their initial proposal of French TIRADS in 2013 [48], which was also recently supported by the work of Borlea et al. [67]. Due to superior differential diagnostic accuracy, the combined use of USE techniques and a TIRADS system has also been strongly recommended by many other groups [68, 69, 70, 71, 72, 73, 74] (► **Table 1**).

The high diagnostic accuracy of USE, demonstrated in all of these studies, was observed especially in papillary thyroid carcinoma (PTC). Other types of thyroid cancer, such as follicular carcinoma (FTC), medullary carcinoma (MTC), and anaplastic carcinoma (ATC), often have low stiffness values [7].

However, in spite of its good accuracy, US-elastography should be avoided in the evaluation of lesions with largely intralesional calcifications and cystic tensile areas due to possible false-positive results [75].

RECOMMENDATION:

- Ultrasound elastography is a useful part of multiparametric ultrasound for thyroid nodule characterization and may be used to improve TIRADS assessment. LoE 2a, weak recommendation (For: 20, Abstain: 0, Against: 0).
- Strain ultrasound elastography performs better than shear wave elastography, but both may be used. LoE 2a, weak recommendation (For: 20, Abstain: 0, Against: 0).

PICO 4: What is the role of contrast-enhanced ultrasound (CEUS)?

- *Which CEUS method (qualitative; quantitative) is preferred for the characterization of thyroid nodules?*

Contrast-enhanced US (CEUS) is used for the analysis of macro- and micro-vascularization patterns [9]. Recently, the applicability of CEUS in thyroid-related disease has improved with the development of second-generation contrast agents [76]. The most recent meta-analyses from Europe and China reported a pooled sensitivity, specificity, positive predictive value, and negative predictive value of CEUS in the diagnosis of malignant thyroid nodules of 85–87%, 82–83%, 83%, and 85%, respectively [77, 78]. However, one must take into account that papillary thyroid cancers were predominant in the malignant study cohorts. Therefore, their characteristics contributed to the main diagnostic criteria – hypo-enhancement owing to the presence of fibrosis, necrosis, or calcifications. Benign nodules mostly represent a nodular goiter or adenomas, presenting with homogeneous enhancement because of a rich blood supply.

The data regarding the size of the nodules as a confounding factor for CEUS characterization is controversial, although a number of studies suggested that CEUS has a higher specificity in nodules less than 1 cm [9, 15, 19, 77, 78, 79, 80].

In the light of the different studies and recent meta-analysis results, the qualitative CEUS method appears to be changing as a result of the growing availability of sufficient quantitative post-processing software and different radiomics features that can be characterized by means of artificial intelligence models. These show promising results and may establish CEUS as a valuable part of multiparametric US assessment where the combined performance has reached an AUC of 0.88 for thyroid nodule characterization [81].

- *Does CEUS improve the detection/diagnosis of cancer and characterization of nodules compared to TIRADS for the characterization of thyroid nodules?*

In some studies, according to a meta-analysis by Wu et al. [82], the false-negative diagnosis of papillary carcinoma could be caused by the absence of prominent neovascularization in micropapillary carcinoma and the degeneration that may reduce the vascular density of nodules, thus resulting in the lack of contrast uptake [82]. At the same time, some malignant nodules (medullary carcinoma and lymphoma) have equal enhancement or hyperenhancement and are often confused with benign nodules [82, 83].

Most studies evaluating CEUS in combination with TIRADS systems demonstrated a diagnostic improvement with an overall increase in sensitivity from 69.72% to 94.74%, specificity from 68.75% to 93.33% [79, 81, 84, 85, 86], and AUC from 0.775 to 0.877 [79, 80]. In the study by Jin et al. [79], CEUS in combination with C-TIRADS showed a reduction in the sensitivity of TIRADS (from 85.7% to 80.9%) and an increase in its specificity and AUC (from 73.6% to 90.6% and from 0.845 to 0.918, respectively). Recently, a thyroid CEUS reporting system was proposed by Ruan et al., resulting in CEUS TIRADS category determination [87].

Non-solid composition, hyperechoic or isoechoic appearance, wider-than-tall shape, smooth or ill-defined margin, absence of calcification, absence of extrathyroidal extension, scattered enhancement direction, iso-enhancement or non-enhancement, and absence of ring enhancement were assigned zero points suggestive of benign features. Centrifugal/centripetal enhancement direction, peak intensity (hyper or hypo), and absent ring enhancement in irregular, hypoechoic solid nodule with calcifications were significant predictors of thyroid carcinoma defined by combined points, resulting in categories T1 (0 points), T2 (1 point), T3 (2 points), T4 (3 points) and T5 (4 points), respectively. The AUC of CEUS TI-RADS was 0.93 [95 % CI: 0.92–0.95] showing a promising benefit of lowering the rate of unnecessary biopsies to 34% in comparison to variable TIRADS systems (46–64%) [87].

A growing number of studies are assessing the diagnostic accuracy of CEUS combined with ultrasound elastography, indicating that the combination enhances diagnostic sensitivity and specificity of thyroid nodule characterization (► **Table 1**).

RECOMMENDATIONS:

- CEUS, including qualitative and quantitative diagnostic criteria, may be used as an additional modality within multiparametric ultrasound protocols for thyroid nodule characterization. LoE 2a, strong recommendation (For: 20, Abstain: 0, Against: 0)
- Thyroid CEUS is still an active research field, and criteria should be weighted and standardized before integration into the existing TIRADS systems. LoE 2b, strong recommendation (For: 20, Abstain: 0, Against: 0)

Contributors' Statement

Vito Cantisani: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. Maija Radzina: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. Christoph F. Dietrich: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. Christian Jenssen: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. Helmut Prosch: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. Liat Appelbaum: Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Writing – original draft. Richard G Barr: Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Writing – original draft. Kunwar S S Bhatia: Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Writing – original draft. Manjiri Dighe: Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Writing – original draft. Cosimo Durante: Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Writing – original draft. Daniele Fresilli: Data curation, Formal analysis, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing. Giorgio Grani: Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Writing – original draft. Chris Harvey: Data curation, Formal analysis, Investigation, Methodology, Resources, Validation, Writing – original draft. Pintong HUANG: Data curation, Formal analysis,

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Conflict of Interest

Cantisani: Samsung, Mindray, Bracco, Siemens, Canon lecturer fees. Radzina: Canon, Mindray, Bracco, SonoScape – lecture honoraria, clinical advisor. Jenssen: NovoNordisk Lectures honoraria, support for ultrasound courses from Fujifilm, GE HelathCare, Canon, Bracco, Siemens, Mindray, Samsung, Youkey, Vinno, SonoScape, Pflugbeil, Pajunk and Kröner Medizintechnik. Dietrich: Speaker Honoraria, other support: AbbVie, Bracco, Fuji, GE, Janssens, Olympus, Samsung, Siemens, SonoScape, Youkey. Harvey: Bracco, GE. Lim: Bracco, GE, Canon, Siemens, Samsung, Fujifilm, Phillips. Secil: Philips, Samsung lecturer honoraria. Todsen: Johnson and Johnson. Ivanac: GE speaker honoraria. Prosch: Speaker honoraria: AstraZeneca, BMS, Boehringer Ingelheim, Bracco, Daiichi Sankyo, Janssen, MSD, Novartis, Roche, Sanofi, Siemens Healthineers, Takeda; advisory Boards: BMS, Boehringer Ingelheim, Janssen, MSD, Roche, Sanofi; travel grants: Boehringer Ingelheim; research support: Boehringer Ingelheim, AstraZeneca, Siemens Healthineers and the Christian Doppler Research Association, EU Commission (EU4Health, Horizon Europe Health).

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