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● *Review*

STATEMENT AND RECOMMENDATIONS ON INTERVENTIONAL ULTRASOUND AS A THYROID DIAGNOSTIC AND TREATMENT PROCEDURE

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Abstract—The recently published guidelines of the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) on interventional ultrasound (INVUS)-guided procedures summarize the intended interdisciplinary and multiprofessional approach. Herewith, we report on recommendations for interventional procedures for diagnosis and treatment of the thyroid gland. (E-mail: Christoph.dietrich@ckbm.de) **© 2017 World Federation for Ultrasound in Medicine & Biology. All rights reserved.**

Key Words: **Guideline, Ultrasound guidance, Abscess, Carcinoma, Metastases, Percutaneous ablation, Thermal ablation, Drainage, Safety.**

INTRODUCTION

The recently published guidelines of the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) on interventional ultrasound (INVUS)-guided procedures summarize the intended interdisciplinary and multiprofessional approach (Dietrich et al. 2015b, 2016a, 2016b; Fusaroli et al. 2016; Jenssen et al. 2016a, 2016b, 2016c; Lorentzen et al 2015a, 2015b; Sidhu et al. 2015a, 2015b). A foreword and introduction (Dietrich et al. 2015b) and aims of EFSUMB guidelines on interventional ultrasound, as well as a guide for the EFSUMB website (Cosgrove et al 2013; Dietrich et al 2017), have been published. In addition, an introduction to dynamic contrast-enhanced ultrasound (DCE-US) for quantification of tumor perfusion was published as well (Dietrich et al. 2012). EFSUMB elastography guidelines were introduced in 2013 (Bamber et al. 2013; Cosgrove et al 2013) and followed by guidelines of the World Federation of Ultrasound in Medicine and Biology (WFUMB) 2 y later (Barr et al. 2015; Ferraioli et al. 2015; Shiina et al. 2015) and in 2017 (thyroid and prostate) (Barr et al. 2017; Cosgrove et al. 2017). The reader is referred to the current published textbook on interventional ultrasound, which was a motivation for more evidence-based recommendations on thyroid interventional procedures (Dietrich and Nuernberg 2011, 2014).

Characterization of thyroid pathologies using standard ultrasound criteria is the prerequisite to biopsy and treatment. The malignancy risk of thyroid nodules can be stratified by Thyroid Imaging Reporting and Data System (TIRADS) according to US patterns by combining solidity, echogenicity and suspicious US features. The proposed risk stratification system based on solidity and echogenicity has proved to be useful for risk stratification and management decision of thyroid nodules (Cosgrove et al. 2017; Dighe et al. 2017a; Friedrich-Rust et al. 2013; Grani et al. 2016; Na et al. 2016; Singaporewalla et al. 2017; Trimboli et al. 2017). For more details, we refer to the published

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guidelines (Haugen et al. 2016) and, most currently, state-of-the-art reviews (Cosgrove et al. 2017; Dighe et al. 2017a, 2017b). Here, biopsy and treatment techniques are discussed.

BIOPSY TECHNIQUES

Fine-needle aspiration

Ultrasound (US)-guided fine-needle aspiration (FNA) is widely accepted as the primary diagnostic method for evaluating thyroid nodules because it is simple, tolerable and cost effective and can be repeated (Choi et al. 2015; Polyzos et al. 2008). Thyroid nodule FNA cytology should be reported using diagnostic groups outlined in the Bethesda System for reporting thyroid cytopathology (Crippa et al. 2010; Ha et al. 2017).

According to the 2015 American Thyroid Association management guidelines for adult patients with thyroid nodules and differentiated thyroid cancer (Haugen et al. 2016), FNA is the procedure of choice in the evaluation of thyroid nodules, when clinically indicated (strong recommendation, high-quality evidence).

Thyroid nodule diagnostic FNA is recommended for:

1. Nodules >1 cm in greatest dimension with a high suspicion sonographic pattern (strong recommendation, moderate-quality evidence).
2. Nodules >1 cm in greatest dimension with an intermediate suspicion sonographic pattern (strong recommendation, low-quality evidence).
3. Nodules >1.5 cm in greatest dimension with a low suspicion sonographic pattern (weak recommendation, low-quality evidence).
4. Nodules >2 cm in greatest dimension with very low suspicion sonographic pattern (weak recommendation, moderate-quality evidence) (Brito et al. 2013; Haugen et al. 2016).

Retrospective studies have reported lower rates of both non-diagnostic and false-negative cytology from FNA procedures performed under US guidance compared with palpation (American Thyroid Association Guidelines Taskforce on Thyroid Nodules and Differentiated Thyroid Cancer et al 2009; Haugen et al. 2016). After an initial non-diagnostic cytology result, repeated FNA under US guidance and, if available, on-site cytologic evaluation substantially increase the rate of specimen adequacy (Baloch et al. 2008; Braga et al. 2001; Redman et al. 2006). Repeat FNA under ultrasound guidance will yield a diagnostic cytology specimen in 60%–80% of nodules, particularly when the cystic component is <50% (Choi et al. 2012). Two other reports of consecutive US-guided FNA evaluations in more than 1400 nodules >3 cm with initial benign cytology followed for a mean of 3 y confirmed a lower false-negative rate of <1.5% (Yoon et al. 2011). Thyroid nodules with repeated non-diagnostic results should be followed, as recommended by guidelines (Cosgrove et al. 2017; Haugen et al. 2016; Na et al 2017), with more attention paid to nodules containing calcifications (Espinosa De Ycaza et al. 2016).

Ultrasound-guided FNA with real-time visualization of needle placement in the target nodule decreases the false-negative rate of a benign cytology diagnosis (Alexander et al. 2002; Brito et al. 2014; Cesur et al. 2006; Smith-Bindman et al. 2013).

In the subset of patients with low serum thyroid-stimulating hormone (TSH) levels who have undergone radionuclide thyroid scintigraphy suggesting nodularity, ultrasound should also be performed to evaluate both the presence of nodules concordant with the hyper-functioning areas on the scintigraphy scan, which do not require FNA, and other non-functioning nodules that meet sonographic criteria for FNA (Langer et al. 2011).

In cases of multinodular goiter, fewer than 37% of thyroid carcinomas are found in the dominant nodule (Janczak et al. 2016); therefore, the size of the nodules is not reliable in predicting malignancy and should not be used in decision making (Godazandeh et al. 2016; Janczak et al. 2016). FNA is the most cost-effective method for evaluation of thyroid nodules. Recent studies that applied the criteria and terminology of the Bethesda system to a large series of patients have achieved relatively good concordance in reporting FNA cytology, with 89%–95% of samples being satisfactory for interpretation, 55%–74% reported as definitively benign and 2%–5% reported as definitively malignant (Bongiovanni et al. 2012; Crippa et al. 2010; Luu et al. 2011; Theoharis et al. 2009).

Limitations. Fine-needle aspiration has several limitations because of its low specificity (Kavanagh et al. 2017; Kim et al. 2005b) in distinguishing primary thyroid anaplastic carcinoma from metastatic, high-grade malignancy (Ha et al. 2017). Given these limitations, core-needle biopsy (CNB) resulting in histologic specimen or surgical excision may be required to confirm the diagnosis. Another limitation of FNA is the possibility of obtaining inadequate target cells from the sample material; inadequacy rates up to 33.6% have been reported (Nachiappan et al. 2014).

Core needle biopsy

Core-needle biopsy is recommended only in cases of thyroid nodules with repeated inadequate FNA cytology, suspicious anaplastic carcinoma, metastasis (*e.g.,* renal cell carcinoma (Mirallié et al. 2005) or lymphoma (Gharib et al 2010). CNB is suggested as the method of choice for thyroid nodules that are initially evaluated as cellular atypia or follicular lesion of undetermined significance (Choi et al. 2017; Hahn et al. 2017; Lee et al. 2014b; Na et al. 2012a), medullary thyroid carcinoma, calcified thyroid nodules and