Annales d'Endocrinologie 83 (2022) 389–394

Available online at
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com/en

SFE-AFCE-SFMN 2022 consensus on the management of thyroid nodules

SFE-AFCE-SFMN 2022 Consensus on the management of thyroid nodules : Recommendations in thyroid cytology: from technique to interpretation

M. Decaussin-Petrucci[a,*], F. Albarel[b], E. Leteurtre[c], F. Borson-Chazot[d,e], B. Cochand Priollet[f,g]

[a] *Pathology Department, Centre Hospitalier Lyon Sud, Hospices Civils de Lyon, Pierre Bénite, France, EA 3738, Lyon 1 University, Lyon, France*
[b] *Service d'Endocrinologie, Assistance Publique-Hôpitaux de Marseille (AP-HM), Hôpital de la Conception, Centre de Référence des Maladies Rares de l'Hypophyse HYPO, 13005 Marseille, France*
[c] *University Lille, CNRS, Inserm, CHU Lille, UMR9020-U1277 - CANTHER–Cancer Heterogeneity Plasticity and Resistance to Therapies, 59000 Lille, France*
[d] *Fédération d'Endocrinologie, Hospices Civils de Lyon, Groupement Hospitalier Est, Bron, France*
[e] *Université Lyon 1, Claude Bernard, Lyon, France*
[f] *Hôpital Cochin, Paris 75014, France*
[g] *APHP Centre; université Paris-Cité, Paris, France*

ARTICLE INFO

Keywords:
Consensus
Thyroid
Cytology
Recommendations

ABSTRACT

The SFE-AFCE-SFMN 2022 consensus deals with the management of thyroid nodules, a condition that is a frequent reason for consultation in endocrinology. In more than 90% of cases, patients are euthyroid, with benign non-progressive nodules that do not warrant specific treatment. The clinician's objective is to detect malignant thyroid nodules at risk of recurrence and death, toxic nodules responsible for hyperthyroidism or compressive nodules warranting treatment.

The diagnosis and treatment of thyroid nodules requires close collaboration between endocrinologists, nuclear medicine physicians and surgeons, but also involves other specialists. Therefore, this consensus statement was established jointly by 3 societies: the French Society of Endocrinology (SFE), French Association of Endocrine Surgery (AFCE) and French Society of Nuclear Medicine (SFMN); the various working groups included experts from other specialties (pathologists, radiologists, pediatricians, biologists, etc.). This section deals with the technique and interpretation of thyroid fine-needle aspiration biopsy (FNAB), a reference test for the analysis of thyroid nodules.

Thyroid nodules are very common and mostly benign. Thyroid ultrasound and thyroid fine-needle aspiration biopsy (FNAB) are the reference tests for the analysis of these nodules.

1. What are the requirements for effective cytology?

1.1. FNAB technique

FNAB should be carried out by an experienced operator if possible, especially for rapidly evolving nodules or nodules that are highly suspicious clinically and/or echographically, but also in case of pathology, or treatment that cannot be interrupted, that modifies coagulation, or for FNAB of cervical lymphadenopathy [1]. FNAB should be ultrasound-guided whenever possible, especially in case of multiple nodules, mixed nodules with more than 25% fluid, non-palpable nodules, FNAB for lymphadenopathy, prior non-contributory cytology, or if the patient has a pathology or treatment that modifies coagulation. Ultrasound identification allows correct needle positioning in the nodule to be documented during aspiration; diagnosis is therefore more reliable and more effective than on palpation alone. The needle should not pass through the gel, as this can cover the cell clusters and interfere with cytological interpretation [2–7].

Optimal needle size is 23-27 G for capillary or aspiration techniques; there is no need for a larger needle, which would increase the risk of bleeding and of non-contributory hemorrhagic samples. However, to empty a cyst, which should be done slowly, a larger needle (18-21 G) may be necessary [2,8].

* Corresponding author.
E-mail address: myriam.decaussin-petrucci@chu-lyon.fr
(M. Decaussin-Petrucci).

https://doi.org/10.1016/j.ando.2022.10.004
0003-4266/

The needle should be held in place for a few seconds, with back and forth and radial movements [2], numbering 2 to 5 [1]. This is usually performed without local anesthesia, which may nevertheless be used at the operator's discretion in agreement with the patient [1–3]. In case of non-contributory cytology, repeat FNAB is possible, at a minimum interval of 1 to 3 months [3,9–11].

Some cervical lymph nodes suspected of being secondary sites of thyroid carcinoma may also warrant FNAB. This should be carried out under ultrasound guidance by an experienced operator, in the same way as for a thyroid nodule. In addition, it is recommended that the needle be rinsed with 1 mL 0.9% saline solution (taken in a dry tube) in order to determine thyroglobulin and/or calcitonin level in the rinse liquid [2,3,9,12].

If there is any doubt about whether the nodule is thyroid or parathyroid tissue (biological and/or imaging suspicion), PTH assay can also be performed on the rinse fluid using the same procedure [12].

All of these in-situ tests require optimal delivery conditions.

Complications are rare. Pain (8.9%) and bleeding (0.3 to 2.3%, depending on the study and type of needle), superficial hematoma (<1%) and some vagal discomfort have been reported. Metastatic spread along the needle path is exceptional, with a few cases reported in anaplastic cancer, as is transient recurrent paralysis or transient acute thyroid edema. Very rare hematomas may require drainage, and exceptional cases of infection have been reported [3,6].

Risk of bleeding does not appear to be significantly influenced by anti-coagulant and anti-platelet agents, and interruption should be discussed on a case-by-case basis [2,3,13–15]. The risk/benefit ratio of FNAB and interruption of treatment must be assessed, after discussion between the physician and the operator, to optimize management. In most cases, there is no urgency to perform FNAB. Suggestions for practical management according to treatment are shown in Table 1, founded not on guidelines but on expert opinions based on the experience of several centers. In the particular situation of a patient on anti-coagulant or anti-platelet therapy, it would probably be preferable to validate the decision for FNAB with an experienced practitioner. If it is decided to continue treatment in the patient's interest, FNAB should be carried out under ultrasound guidance by an experienced operator, with a fine 25–27 G needle and the number of passes should be limited. After aspiration, manual compression and local monitoring are recommended for 15–30 minutes [2,3,13]. The patient should be informed of the risk of bleeding, and ultrasound monitoring should be performed if necessary.

Recommendation 3.1–Effective thyroid fine-needle aspiration biopsy relies on optimal technique and the quality cytological interpretation. Level of evidence +++ Grade A

Recommendation 3.2–It is recommended that thyroid fine-needle aspiration biopsy be performed by an experienced operator whenever possible, and guided by ultrasound. Level of evidence +++ Grade A

Recommendation 3.3–It is recommended to use a fine 23–27 gauge needle, with or without aspiration, depending on the characteristics of the nodule. Level of evidence +++ Grade A

Recommendation 3.4–It is recommended that the risk/benefit ratio of discontinuing coagulation-modifying therapy be assessed on an individual basis. Level of evidence ++ Grade A

1.2. Cytology technique

Whatever cytology technique is used, its quality is the basis of the diagnosis and is therefore an essential step. Several good-quality techniques are available and are to be chosen by consensus between the cytopathologist and the operator [2,16–20].

1.2.1. Direct smear

The classic technique consists in placing a large drop at one end of the slide, often on the ground-glass side. It is then spread with another slide, pulling the material at 60–80° to the surface. The slide is then air-dried after immediate shaking for 5 sec and stored at room temperature in an airtight place, and stained with MGG (May-Grünwald Giemsa). If Papanicolaou staining is preferred, fixation (alcoholic liquid fixative or cytospray) should be performed immediately.

Experience is required to assess the quality of the spread and the number of slides to be taken (hemorrhagic or non-hemorrhagic samples) and to measure the pressure on the slides.

1.2.2. Cytocentrifugation

Only for aspiration of a liquid; in this case, the sample vial must be sent to the pathology department very quickly (optimally, in less than 1 hour).

1.2.3. Liquid-based cytology

The choice of the conservation solution is decided by consensus between the pathologist and the radiologist. The pathologist's choice is often decisive because it is related to the equipment available in the cytology department. In all cases, solution must be validated by the French National Drug Safety Agency (ANSM) for complementary techniques.

The technique consists in placing the sampled material in the conservation solution, using a syringe previously filled with the solution, to avoid any aspiration into the needle. The solution contains a mucolytic, a cytolytic and a small amount of alcohol (methanol or ethanol). This is a transport solution: it is important that the sample can then be taken to the cytology department within 2 to 4 hours to ensure complete fixation.

1.2.4. Cell blocks

Several techniques are available and are generally chosen by the cytology department. For the operator, this implies knowing the solution in which the aspirated material is to be placed, and sometimes requires an additional passage. A cell-block method validation study is underway at the EFCS (European Federation of Cytological Societies) in partnership with the UK NEQAS (National External Quality Assessment Site). The recommendations that will be published should serve as a reference.

1.2.5. Special case: microbiopsy

The role of microbiopsy in the diagnosis of thyroid nodules remains to be defined, as there are few well-documented publications at present, and these are mainly Korean [21,22]. This technique significantly reduces the rate of non-diagnostic samples and may be useful in case of solid nodules after 2 non-diagnostic FNABs. It is also discussed in cases of suspected anaplastic carcinoma, metastasis or lymphoma, to enable complementary techniques, particularly immunohistochemistry and molecular biology, which require a high level of cellularity and a specialized technical organization in the cytology department.

Recommendation 3.5–Direct smear thyroid FNAB: learning and experience are required for smear quality. Level of evidence ++ Grade B

Recommendation 3.6–Liquid-based thyroid FNAB: liquid-based cytology eliminates the need to master the direct smear technique. The slide is easily analyzed; the cells are well conserved: complementary techniques are applicable. Level of evidence +++ Grade A

Recommendation 3.7–Cell blocks allow complementary techniques (immunocytochemistry and molecular cytopathology) to be performed more easily. Level of evidence +++ Grade A

Table 1
Suggested practical guidelines for fine-needle aspiration biopsy in patients on antiaggregant/anticoagulant therapy (expert opinions corresponding to current practice in several centers and according to references [2,14,15,42]).

Type of treatment	Molecule	Expert opinion
Anticoagulant	AVK	Possible continuation, INR < 3, 48 h before puncture
	New direct oral anticoagulants (Apixaban, Dabigatran, Rivaroxaban)	Subject to the agreement of the prescribing physician: if taken in the morning and evening: not taken the evening before and the morning of the procedure; if taken in the morning only: not taken on the morning of the procedure; if taken only in the evening: not taken the evening before the procedure. Resumption 6 hours later possible.
Antiplatelet agent	Acetyl salicylic acid 75 or 100 mg/day	Possible continuation
	Clopidogrel	Possible continuation (or relay aspirin and 5 days off if the prescribing physician agrees)
	Ticagrelor	Possible continuation (or relay aspirin and 5 days off if the prescribing physician agrees)
	Prasugrel	Possible continuation (or relay aspirin and 7 days off if the prescribing physician agrees)
	Bi-aggregation	Weigh carefully the indication for FNAB and, if confirmed, after agreement of the prescriber, stop 5 days Clopidogrel/Ticagrelor and 7 days Prasugrel; and puncture with acetylsalicylic acid ONLY
Heparin	HBPM heparin	Carefully weigh the benefit-risk of the indication for FNAB against the temporary discontinuation of heparin and, if confirmed by prescribing physician, skip the last injection

Table 2
BETHESDA SYSTEM 2017: diagnostic categories [24].

Diagnostic categories
I: Non diagnostic or unsatisfactory
Cyst fluid only
Virtually acellular specimen (less than 6 groups of 10 cellules)
other: technical problems, obscuring blood,...
II: Benign
benign follicular nodule: adenomatoid nodule, colloid nodule, follicular adenoma etc.
Thyroiditis: chronic lymphocytic, granulomatous (subacute), other.
III: Atypia of Undetermined Significance or Follicular lesion of Undetermined Significance[a]
IV: Follicular Neoplasm or Suspicious for a Follicular Neoplasm[a]
V: Suspicious for Malignancy
Suspicious for papillary thyroid carcinoma
Suspicious for medullary thyroid carcinoma
Suspicious for metastatic carcinoma
Suspicious for lymphoma
other: anaplastic carcinoma, poorly differentiated,...
VI: Malignant
papillary thyroid carcinoma
medullary thyroid carcinoma
anaplastic carcinoma
Metastasis
Lymphoma
other

[a] The two terms are synonymous. Each laboratory should choose only one for reporting results.

Recommendation 3.8–Microbiopsy of a thyroid nodule is useful for solid nodules after at least 2 non-diagnostic FNABs. Level of evidence ++ Grade A

2. How to analyze thyroid cytology

2.1. Bethesda system

The international terminology for thyroid cytology is the Bethesda system [23–26] (Table 2). This classification has the advantage of:

- defining the diagnostic criteria, with explanatory notes and figures;
- specifying the risk of malignancy;
- detailing management for each of the 6 categories.

In 2022, at European and international level, the majority of thyroid cytologies are analyzed on the Bethesda system. A few countries (Italy, UK and Japan) use their own classifications, but it is possible to link categories between classifications [27]. More recently, scores combining several components (imaging, cytology, clinical data, molecular alterations) have been proposed to improve the management of thyroid nodules [27–30].

2.1.1. The Bethesda categories

Category I, "non-diagnostic" (ND), comprises 1) all cases with fewer than 6 clusters of 10 well-preserved follicular cells, 2) FNABs with poorly conserved, altered cells, and 3) cyst FNABs with or without histiocytes and fewer than 6 clusters of 10 thyreocytes.

Category II, "benign" (B) comprises benign follicular nodules and thyroiditis.

Category III, "follicular lesion of undetermined significance" or "atypia of undetermined significance": the cytologist may choose either of the terminologies, as they do not correspond to different situations, but should always use the same terminology in the reports. Category III should be used as a last resort, and not as a "catch-all" category.

For category IV, a choice between two terms "follicular neoplasm (FN)/suspicion of follicular neoplasm" is possible, but the cytopathologist should always use the same terminology in reporting. This category corresponds to cytologies often rich in microfollicles. Cytologies that combine this microfollicular architecture with moderate cytological abnormalities may suggest NIFTP (Non-invasive follicular thyroid neoplasm with papillary-like nuclear features). This entity was proposed in 2016 and introduced in the World Health Organization classification of thyroid tumors in 2017 [31–33]. Diagnosis can only be made after complete examination of the capsule on the surgical specimen; it is therefore not possible to diagnose on cytology. The criteria to define this low-risk

Table 3
Histological and molecular diagnostic criteria for NIFTP[a] [31–33].

Histological and molecular diagnostic criteria for NIFTP[a]
Any size
Encapsulated/well limited
Follicular architecture:
<1% true papillae
No psammoma bodies
Nuclear grade 2–3
Absence of vascular invasion
Absence of capsular invasion
< 30% solid/insular/trabecular
Absence of tumor necrosis
Mitoses < 3/10 HPF
Absence of BRAF V600E mutation
RAS-Like Mutations (50–60% of cases)

[a] NIFTP: non-invasive follicular thyroid neoplasm with papillary-like nuclear features.

tumor are strict (see Table 3). For cytologies of microfollicular architecture with papillary-type abnormalities, an explanatory note may be added to suggest the possibility of NIFTP. Category IV includes a subcategory of "follicular oncocytic cell neoplasm/suspicion of follicular oncocytic cell neoplasm" for rich cytologies consisting exclusively of oncocytic cells.

Category V, "suspicious for malignancy" (SM), is used if the cytological features raise suspicion of malignancy but there is insufficient evidence to confirm this diagnosis. It is necessary to specify the type of cancer suspected: mainly papillary carcinoma, but also medullary carcinoma, poorly differentiated carcinoma, anaplastic carcinoma, lymphoma or metastasis. In the case of suspected papillary carcinoma, the cytology will be classified as category V, SM, with an explanatory note on the possibility of a diagnosis of NIFTP.

Category VI, "malignant" (M), includes all cases where the cytological appearance is suggestive of malignancy: papillary carcinoma, medullary carcinoma, poorly differentiated carcinoma, anaplastic carcinoma, lymphoma or metastasis.

2.1.2. Bethesda terminology and risk of malignancy (ROM)

In the first version of the Bethesda classification [23], risk of malignancy (ROM) was mainly calculated on the basis of retrospective data on operated patients, leading to overestimation (see Table 4). The publication of prospective studies including large cohorts and meta-analyses has changed the ROM. Furthermore, the 2017 and 2022 WHO classifications [31,32] of thyroid tumors profoundly changed the category of encapsulated follicular thyroid tumors, including NIFTP considered as an indolent tumor [33]. This new denomination impacted the second version of the Bethesda classification, lowering the ROM mainly in the indeterminate categories (III and IV) [34–37].

Thus, for the "non-diagnostic" and "benign" categories (I and II), ROM remained stable, at 5–10% and <3% respectively. For category III, ROM is difficult to assess, as patients are not operated on unless they present other suspicious clinical or ultrasound signs; even so, ROM decreased from 10–30% to 6–18%. ROM in category IV, "follicular neoplasm" (FN), is easier to estimate, as these nodules are often operated on. The risk of tumor is 65-85% and of malignancy 10–40% with the development of NIFTP. The appearance of NIFTP also impacted ROM in Bethesda category V, "suspicious for malignancy" (SM), decreasing from 50–75% to 45–60%. For category VI "malignant" (M), ROM remains high at 94-96%, as NIFTP is rarely found in this category.

Recommendation R3.9: Cytology results should be presented using the Bethesda system (Grade A +++), specifying the year of the version (see Table 2).

2.2. Prescription and cytology report

The prescription for cytological analysis must include all the following information:

- concerning the patient: identity, date of birth, relevant personal or family oncological history, genetic syndromes, cervical irradiation, thyroid surgery;
- concerning the operator and the prescriber: identity, contact details;
- concerning the nodule: size, location, EU-TIRADS score, evolution, possible FDG fixation on PET scan, presence of suspicious lymph nodes/lymph-node aspiration;
- biological thyroid status and possible thyroid treatment, calcitonin level, presence of antithyroperoxidase antibodies;
- whether the nodule is likely to be parathyroid and, if so, serum calcium and PTH levels if known.
- concerning the puncture: number of passes and location, need for aspiration or not; number of slides and/or tubes; puncture of lymph node at the same time with or without assay on rinse liquid;
- treatment such as anticoagulants or antiplatelets and, if stopped, for how long, or blood coagulation abnormalities.

For the cytology report, the formulation of the result of a FNAB requires the initial information to be reiterated (concerning the patient, clinical and ultrasound data, characteristics of the nodule) plus identification of the operating and prescribing physicians, cytopathologist, type of material submitted, techniques used, and the result according to the Bethesda terminology [24,38].

Recommendation 3.10–It is recommended to send the FNAB to the cytologist with a form containing information detailing the ultrasound characteristics of the thyroid nodule and the clinical context. Level of evidence ++ Grade A

Recommendation 3.11–The thyroid cytology report should include 1) the Bethesda diagnostic category in full, possibly followed by its number (from I to VI) as often used in common practice, and 2) the cytological diagnosis. Level of evidence +++ Grade A

Recommendation 3.11a–Additional comments or explanatory notes may be added to the report by the cytopathologist. Level of evidence +++ Grade B

Recommendation 3.11b–Management recommendations or risk of malignancy may also be indicated in the report. Level of evidence +++ Grade B

Recommendation 3.11c–The report may be written as free text or as a standardized form. Level of evidence+GradeC

3. Thyroid cytology and complementary methods

3.1. Immunocytochemistry (ICC) and immunohistochemistry (IHC) [16,39–41]

Routine ICC techniques are essential for cytological diagnosis. Different techniques may be used in different cytology departments and are validated by quality assurance procedures. The main indications are to determine the follicular or non-follicular nature of the nodule (parathyroid, medullary carcinoma, lymphoma, metastasis) and to help distinguish benign or malignant lesions of follicular origin.

Recommendation 3.12–Immunocytochemistry/immunohistochemistry techniques are recommended for lesions suspected of being non-follicular (parathyroid, medullary carcinoma, lymphoma, metastases) (Grade A +++) and indeterminate categories (III and IV) of the Bethesda terminology (Grade B ++)

Table 4
BETHESDA SYSTEM 2017: diagnostic categories: Risk of malignancy [24,25].

Diagnostic category	Frequency	Risk of malignancy (%)	Risk of cancer and NIFTP[a] (%)
I: Non-diagnostic	< 15%	5–10%	5–10%
II: Benign	60–70%	0–3%	0–3%
III: Atypia of Undetermined Significance or Follicular lesion of Undetermined Significance	<10%	6–18%	10–30%
IV: Follicular Neoplasm or Suspicious for a Follicular Neoplasm	6–11%	10–40%	25–40%
V: Suspicious for Malignancy	1–6%	45–60%	50–75%
VI: Malignant	5%	94–96%	97–99%

[a] NIFTP: non-invasive follicular thyroid neoplasm with papillary-like nuclear features, considered as a low-risk neoplasm [32].

4. Molecular tests

Molecular analyses in addition to cytology are possible and are being developed in thyroid FNAB to improve the management of cytologically indeterminate nodules (see chapter 4).

Thanks to Dr Agnes Rouxel, Pr Pierre Morange, Dr Geneviève Belleannée, Dr Philippe Viehl, Dr Laetitia Collin, Dr Claire Bournaud, Pr Marc Klein, Pr Bernard Goichot, Pr Marie-Christine Vantyghem and Pr Jean-Louis Wemeau for their suggestions and remarks.

Disclosure of interest

The authors declare that they have no competing interest.

References

[1] Pitman MB, Abele J, Ali SZ, Duick D, Elsheikh TM, Jeffrey RB, et al. Techniques for thyroid FNA: a synopsis of the National Cancer Institute Thyroid Fine-Needle Aspiration State of the Science Conference. Diagn Cytopathol 2008;36:407–24, http://dx.doi.org/10.1002/dc.20829.
[2] Gharib H, Papini E, Garber JR, Duick DS, Harrell RM, Hegedüs L, et al. AACE/ACE/AME Task Force on Thyroid Nodules, American Association of Clinical Endocrinologists, American College of Endocrinology, and Associazione Medici Endocrinologi medical guidelines for clinical practice for the diagnosis and management of thyroid nodules–2016 update. Endocr Pract 2016;22:622–39, http://dx.doi.org/10.4158/EP161208.GL.
[3] Haute Autorité de Santé. Exploration des pathologies thyroïdiennes chez l'adulte: pertinence et critères de qualité de l'échographie, pertinence de la cytoponction échoguidée (Outils d'amélioration des pratiques). Saint-Denis La Plaine: H.A.S; 2021.
[4] Cesur M, Corapcioglu D, Bulut S, Gursoy A, Yilmaz AE, Erdogan N, et al. Comparison of palpation-guided fine-needle aspiration biopsy to ultrasound-guided fine-needle aspiration biopsy in the evaluation of thyroid nodules. Thyroid 2006;16:555–61, http://dx.doi.org/10.1089/thy.2006.16.555.
[5] Fresilli D, David E, Pacini P, Del Gaudio G, Dolcetti V, Lucarelli GT, et al. Thyroid nodule characterization: how to assess the malignancy risk. update of the literature. Diagnostics (Basel) 2021;11:1374, http://dx.doi.org/10.3390/diagnostics11081374.
[6] Feldkamp J, Führer D, Luster M, Musholt TJ, Spitzweg C, Schott M. Fine needle aspiration in the investigation of thyroid nodules. Dtsch Arztebl Int 2016;113:353–9, http://dx.doi.org/10.3238/arztebl.2016.0353.
[7] INCA 2020 Collection "Outils pour la pratique des médecins généralistes - Du diagnostic au suivi" Cancers de la thyroïde.
[8] Moss WJ, Finegersh A, Pang J, Califano JA, Coffey CS, Orosco RK, et al. Needle biopsy of routine thyroid nodules should be performed using a capillary action technique with 24- to 27-gauge needles: a systematic review and meta-analysis. Thyroid 2018;28:857–63, http://dx.doi.org/10.1089/thy.2017.0643.
[9] Haugen BR, Alexander EK, Bible KC, Doherty GM, Mandel SJ, Nikiforov YE, et al. 2015 American Thyroid Association Management Guidelines for adult patients with thyroid nodules and differentiated thyroid cancer: the American thyroid association guidelines task force on thyroid nodules and differentiated thyroid cancer. Thyroid 2016;26:1–133, http://dx.doi.org/10.1089/thy.2015.0020.
[10] Lee HY, Baek JH, Yoo H, Kim JK, Lim MK, Chu YC, et al. Repeat fine-needle aspiration biopsy within a short interval does not increase the atypical cytologic results for thyroid nodules with previously nondiagnostic results. Acta Cytol 2014;58:330–4, http://dx.doi.org/10.1159/000363277.
[11] Lubitz CC, Nagarkatti SS, Faquin WC, Samir AE, Hassan MC, Barbesino G, et al. Diagnostic yield of nondiagnostic thyroid nodules is not altered by timing of repeat biopsy. Thyroid 2012;22:590–4, http://dx.doi.org/10.1089/thy.2011.0442.
[12] Trimboli P, D'Aurizio F, Tozzoli R, Giovanella L. Measurement of thyroglobulin, calcitonin, and PTH in FNA washout fluids. Clin Chem Lab Med 2017;55:914–25, http://dx.doi.org/10.1515/cclm-2016-0543.
[13] Abu-Yousef MM, Larson JH, Kuehn DM, Wu AS, Laroia AT. Safety of ultrasound-guided fine needle aspiration biopsy of neck lesions in patients taking antithrombotic/anticoagulant medications. Ultrasound 2011;Q27:157–9, http://dx.doi.org/10.1097/RUQ.0b013e31822b5681.
[14] Haute Autorité de Santé. Les anticoagulants oraux. Saint-Denis La Plaine: HAS; 2018.
[15] Dictionnaire Vidal®. Available at: https://www.vidal.fr/medicaments.html.
[16] Filie AC, Asa SL, Geisinger KR, Logani S, Merino M, Nikiforov YE. Utilization of ancillary studies in thyroid fine needle aspirates: a synopsis of the National Cancer Institute Thyroid Fine Needle Aspiration State of the Science Conference. Diagn Cytopathol 2008;36:438–41, http://dx.doi.org/10.1002/dc.20831.
[17] Torous VF, Chen Y, VanderLaan PA. Comparison of plasma-thrombin, HistoGel, and CellGel cell block preparation methods with paired ThinPrep slides in the setting of mediastinal granulomatous disease. J Am Soc Cytopathol 2019;8:52–60, http://dx.doi.org/10.1016/j.jasc.2018.09.001.
[18] Rollins SD, Teaching FNA. Teaching FNA techniques and ultrasound guided FNA. Cancer Cytopathol 2019;127:7–8, http://dx.doi.org/10.1002/cncy.22064.
[19] Rekhtman N, Buonocore DJ, Rudomina D, Friedlander M, Dsouza C, Aggarwal G, et al. Novel modification of HistoGel-Based cell block preparation method: improved sufficiency for molecular studies. Arch Pathol Lab Med 2018;142:529–35, http://dx.doi.org/10.5858/arpa.2017-0030-OA.
[20] Bode-Lesniewska B, Cochand-Priollet B, Straccia P, Fadda G, Bongiovanni M. Management of thyroid cytological material, preanalytical procedures and biobanking. Cytopathology 2019;30:7–16, http://dx.doi.org/10.1111/cyt.12586.
[21] Trimboli P, Giovanella L. Reliability of core needle biopsy as a second-line procedure in thyroid nodules with an indeterminate fine-needle aspiration report: a systematic review and meta-analysis. Ultrasonography 2018;37:121–8, http://dx.doi.org/10.14366/usg.17066.
[22] Kwangsoon K, Ja SB, Jeong SK, So LJ, Chan KJ. Diagnostic performance of thyroid core needle biopsy using the revised reporting system: comparison with fine needle aspiration cytology. Endocrinology and metabolism (Seoul, Korea) 2022:37, http://dx.doi.org/10.3803/EnM.2021.1299.
[23] Cibas ES, Ali SZ. The Bethesda system for reporting thyroid cytopathology. Thyroid 2009;19:1159–65, http://dx.doi.org/10.1089/thy.2009.0274.
[24] Ali SZ, Cibas ES, editors. The Bethesda system for reporting thyroid cytopathology. Cham: Springer International Publishing; 2018., http://dx.doi.org/10.1007/978-3-319-60570-8.
[25] Cibas ES, Ali SZ. The 2017 Bethesda system for reporting thyroid cytopathology. J Am Soc Cytopathol 2017;6:217–22, http://dx.doi.org/10.1016/j.jasc.2017.09.002.
[26] Baloch Z, LiVolsi VA. The Bethesda System for Reporting Thyroid Cytology (TBSRTC): from look-backs to look-ahead. Diagn Cytopathol 2020;48:862–6, http://dx.doi.org/10.1002/dc.24385.
[27] Poller DN, Cochand-Priollet B, Trimboli P. Thyroid FNA terminology: the case for a single unified international system for thyroid FNA reporting. Cytopathology 2021;32:714–7, http://dx.doi.org/10.1111/cyt.13017.
[28] Alexander EK, Faquin WC, Krane JF. Highlights for the cytology community from the 2015 American Thyroid Association clinical guidelines on the management of thyroid nodules and well-differentiated thyroid cancer. Cancer Cytopathol 2016;124:453–6, http://dx.doi.org/10.1002/cncy.21662.
[29] Colombo C, Muzza M, Pogliaghi G, Palazzo S, Vannucchi G, Vicentini L, et al. The thyroid risk score (TRS) for nodules with indeterminate cytology. Endocr Relat 2021;Cancer 28:225–35, http://dx.doi.org/10.1530/ERC-20-0511.
[30] Tan H, Li Z, Li N, Qian J, Fan F, Zhong H, et al. Thyroid imaging reporting and data system combined with Bethesda classification in qualitative thyroid nodule diagnosis. Medicine (Baltimore) 2019;98:e18320, http://dx.doi.org/10.1097/MD.0000000000018320.
[31] Organisation mondiale de la santé, Centre international de recherche sur le cancer, editors. WHO classification of tumours of endocrine organs,. 4th ed World health organization classification of tumours Lyon: International agency for research on cancer; 2017.
[32] Baloch ZW, Asa SL, Barletta JA, Ghossein RA, Juhlin CC, Jung CK, et al. Overview of the 2022 WHO classification of thyroid neoplasms. Endocr Pathol 2022;33:27–63, http://dx.doi.org/10.1007/s12022-022-09707-3.
[33] Nikiforov YE, Seethala RR, Tallini G, Baloch ZW, Basolo F, Thompson LD, et al. Nomenclature Revision for Encapsulated Follicular Variant of Papillary Thyroid Carcinoma: A Paradigm Shift to Reduce Overtreatment of Indolent Tumors. JAMA Oncol 2016;2:1023–9, http://dx.doi.org/10.1001/jamaoncol.2016.0386.
[34] Zhou H, Baloch ZW, Nayar R, Bizzarro T, Fadda G, Adhikari-Guragain D, et al. Noninvasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP): Implications for the risk of malignancy (ROM) in the Bethesda

System for Reporting Thyroid Cytopathology (TBSRTC). Cancer Cytopathol 2018;126:20–6, http://dx.doi.org/10.1002/cncy.21926.
[35] Layfield LJ, Baloch ZW, Esebua M, Kannuswamy R, Schmidt RL. Impact of the reclassification of the non-invasive follicular variant of papillary carcinoma as benign on the malignancy risk of the bethesda system for reporting thyroid cytopathology: a meta-analysis study. Acta Cytol 2017;61:187–93, http://dx.doi.org/10.1159/000469654.
[36] Lau RP, Paulsen JD, Brandler TC, Liu CZ, Simsir A, Zhou F. Impact of the reclassification of "Noninvasive Encapsulated Follicular Variant of Papillary Thyroid Carcinoma" to "Noninvasive Follicular Thyroid Neoplasm With Papillary-Like Nuclear Features" on the Bethesda system for reporting thyroid cytopathology: a large academic institution's experience. Am J Clin Pathol 2017;149:50–4, http://dx.doi.org/10.1093/ajcp/aqx136.
[37] Bongiovanni M, Faquin WC, Giovanella L, Durante C, Kopp P, Trimboli P. Impact of non-invasive follicular thyroid neoplasms with papillary-like nuclear features (NIFTP) on risk of malignancy in patients undergoing lobectomy/thyroidectomy for suspected malignancy or malignant fine-needle aspiration cytology findings: a systematic review and meta-analysis. Eur J Endocrinol 2019;181:389–96, http://dx.doi.org/10.1530/EJE-19-0223.
[38] Poller DN, Johnson SJ, Bongiovanni M. Measures to reduce diagnostic error and improve clinical decision making in thyroid FNA aspiration cytology: a proposed framework. Cancer Cytopathol 2020;128:917–27, http://dx.doi.org/10.1002/cncy.22309.
[39] Srebotnik Kirbiš I, Rodrigues Roque R, Bongiovanni M, Strojan Fležar M, Cochand-Priollet B. Immunocytochemistry practices in European cytopathology laboratories-Review of European Federation of Cytology Societies (EFCS) online survey results with best practice recommendations. Cancer Cytopathol 2020;128:757–66, http://dx.doi.org/10.1002/cncy.22311.
[40] Cochand-Priollet B, Dahan H, Laloi-Michelin M, Polivka M, Saada M, Herman P, et al. Immunocytochemistry with cytokeratin 19 and anti-human mesothelial cell antibody (HBME1) increases the diagnostic accuracy of thyroid fine-needle aspirations: preliminary report of 150 liquid-based fine-needle aspirations with histological control. Thyroid 2011;21:1067–73, http://dx.doi.org/10.1089/thy.2011.0014.
[41] Rossi ED, Martini M, Capodimonti S, Cenci T, Bilotta M, Pierconti F, et al. Morphology combined with ancillary techniques: an algorithm approach for thyroid nodules. Cytopathology 2018;29:418–27, http://dx.doi.org/10.1111/cyt.12555.
[42] Bécamel S, Frandon J, Goupil J, Mihaila A, Viala P, Freitag C, et al. Gestion des anticoagulants et antiagrégants en radiologie interventionnelle: prise en charge des risques. Journal d'Imagerie Diagnostique et Interventionnelle 2020;3:223–5, http://dx.doi.org/10.1016/j.jidi.2020.02.010.