Thyroid Ultrasound: Standard Ultrasound Assessment and Reporting

EFW Radiology Medical Brief

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EPIDEMIOLOGY

Thyroid nodules are a common clinical problem. An autopsy study found 50% of patients with no clinical history of thyroid disease had thyroid nodules, and the majority were multiple [1]. Diagnostic imaging can also reveal subclinical thyroid nodules. The prevalence rate of these thyroid incidentalomas is 18- 25% with MRI and CT imaging [2,3,4], up to 67% with ultrasound (US) imaging [5,6], and 1-2 % on FDG positron emission tomography (PET) [4,7]. In the absence of clinical risk factors, the risk of malignancy is between 5-13% when discovered by US, CT, or MRI [8,9] and 30% if based on PET [10]. Largely due to the widespread use of imaging, the yearly incidence of thyroid cancer has almost tripled from 4.9 per 100,000 in 1975 to 14.3 per 100,000 in 2009, with increasing proportion of cancers measuring < 1cm [11]. This increased diagnosis of small thyroid cancers has not resulted in more favourable outcomes. In fact, over the last thirty years, mortality rates from thyroid malignancy have remained stable [11]. In light of the evidence, a recent report from South Korea describes the increased detection of small relatively indolent thyroid cancers as a “thyroid cancer epidemic” [12], an experience also seen in Western countries [13]. To compound the problem, the diagnosis and treatment of thyroid cancer is not without its own inherent risks. Total thyroidectomy may be complicated by hypocalcemia from parathyroid gland damage and vocal cord dysfunction from inadvertent sectioning of the recurrent laryngeal nerve. To reduce overdiagnosis and overtreatment, recently revised guidelines (ATA, AACE/AME)* advocate thyroid nodule malignancy risk assessment and risk stratified de-escalated treatment strategies. These guidelines have been adopted by the Provincial Endocrine Tumour Team and are endorsed by the University of Alberta and University of Calgary thyroid cancer tumour groups.

INITIAL MANAGEMENT

Thyroid nodules are usually assessed with clinical parameters followed by diagnostic ultrasound. Patients in which the TSH is subnormal may also benefit from a radionuclide thyroid scan to determine if the nodule is autonomously functioning and therefore likely benign. If the TSH is normal or elevated, a radionuclide imaging should not be performed as an initial evaluation [14]. Ultimately, the decision to biopsy a thyroid nodule is generally determined by the sonographic features with less consideration given to the size of the lesion.

CHARACTERIZATION OF THYROID NODULES WITH ULTRASOUND

The goal of US risk stratification is to detect those lesions at highest risk of malignancy and to select which nodules should undergo FNA biopsy. The consensus by the Provincial Endocrine Tumour Team and AMA Endocrinology Section has been to use the American Thyroid Association (ATA) 2015 Guidelines to characterize thyroid nodules. The most critical step is the evaluation of US features that may be associated with increased malignant risk. Features assessed include internal content (solid vs. cystic), shape, margins, echogenicity, and calcifications. Vascularity is evaluated but has not been shown to help predict malignancy. The vast majority of thyroid cancers are solid (82-91%) [15-20] and the decision to biopsy partially cystic nodules must take into account their lower malignant risk. The solid components of the lesion are evaluated for suspicious features which include: taller-than-wide shape, spiculated/microlobulated margins, markedly hypoechoic echogenicity, microcalcifications, and disrupted rim calcifications (+/- extra-nodular soft tissue component) [14, 21-24]. The presence of a single suspicious feature elevates the risk to high suspicion; however, multiple suspicious features are additive and increase the malignant risk [14, 15, 25]. Just as there are sonographic features which have a high suspicion pattern, there are several distinct forms which are strongly correlated with benignity. A spongiform nodule is the aggregation of multiple cysts comprising >50% of nodule volume, with a malignant risk < 3 % [14]. As such, FNA biopsy for spongiform nodules is generally not recommended. Simple cysts are considered benign and require no intervention unless for symptomatic reasons.

US features are the most important imaging factor in assessing malignant risk; however, nodule size and volume should also be assessed. Ongoing research is examining whether or not size is truly relevant, and there is a paucity of good data to suggest that even statistically significant size change predicts the risk of malignancy. Nevertheless, current ATA 2015 Guidelines suggest that size should factor into management decisions. In fact, each malignant risk category has a maximum size (usually based on the largest dimension of a nodule) above which FNA should be considered. Interestingly, biopsy is generally not recommended for lesions less than 1 cm regardless of the sonographic characteristics. Changes in nodule volume of ≥ 50% can be interpreted as growth or regression, and changes of < 50% may be attributable to inter-observer variability [26]. It should be noted that determining volume change for very small nodules is challenging as small statistical variation in measurement may mathematically overestimate change. Volume change in lesions measuring <10 mm should therefore be interpreted with caution.

AMERICAN THYROID ASSOCIATION RISK STRATIFICATION SYSTEM

The ATA 2015 Guidelines combine US features into several categories with a definable malignant risk and management strategy [figure 1 & 2]. Please note that biopsy is

generally not recommended for lesions < 1 cm regardless of their sonographic features and malignant risk assessment [12,13, 25].

Figure 1: American Thyroid Association Classification (pictorial).[17]

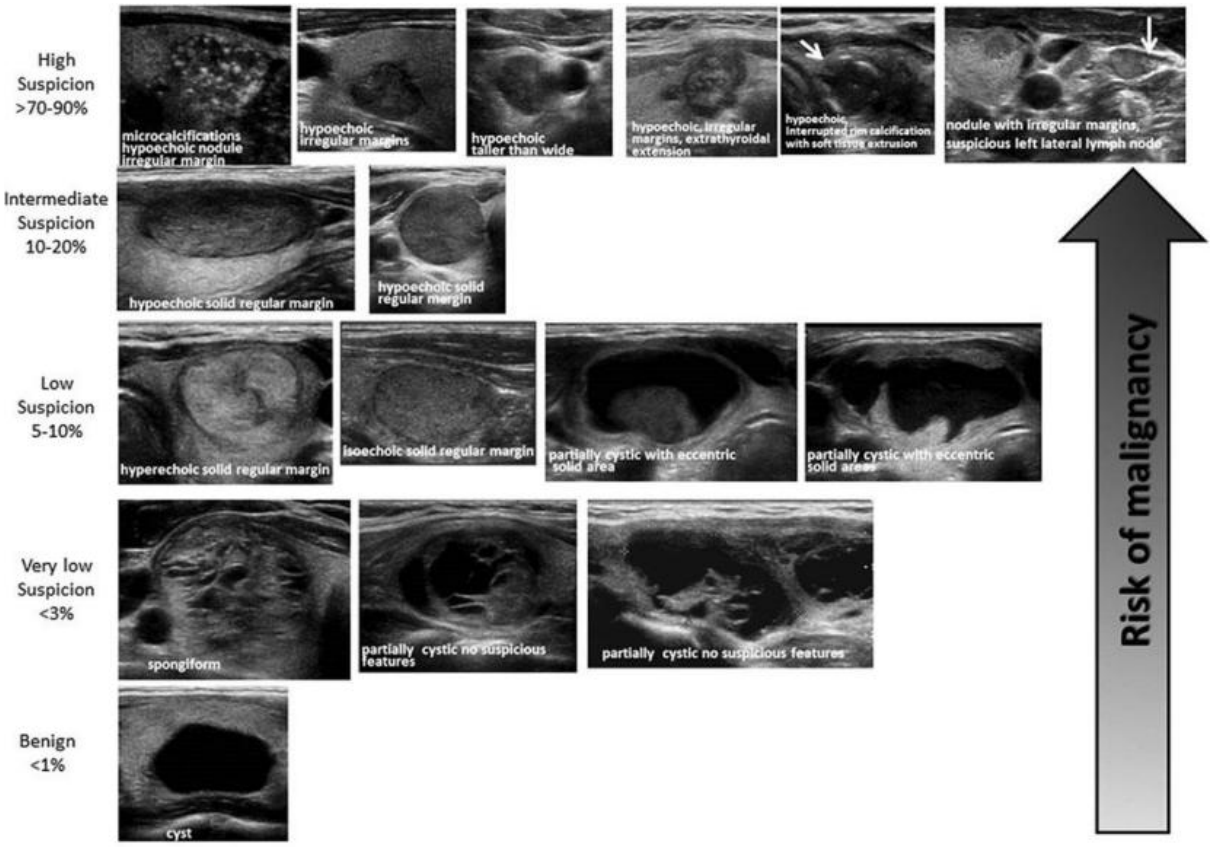
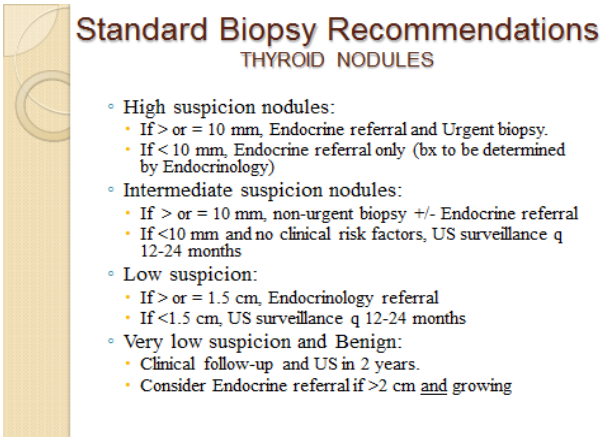


Figure 2:



ETA GUIDELINES ON CERVICAL LYMPH NODES

The European Thyroid Association (ETA) Guidelines for cervical lymph node assessment have been adopted to assess lymph node malignant risk in the setting of current or previous thyroid nodules or cancer. These guidelines stratify nodes into normal, indeterminate, or suspicious based on US features and size. The usefulness of these guidelines was confirmed by a recent evaluation by Lamartina et al [27], but is beyond the scope of this review.

STANDARDIZED PATIENT MANAGEMENT RECOMMENDATIONS

Using sonographic risk stratification, standard management strategies are recommended based on ATA (2015) Guidelines and with the endorsement of the U of C Division of Endocrinology. Small nodules < 5mm in size may not be characterized due to their small size, but generally require no intervention other than clinical and/or US follow-up. If a nodule has any suspicious features, subspecialty Endocrinology assessment is recommended.** High suspicion lesions ≥ 1cm also generally go on to urgent FNA biopsy. Guidelines recommend against biopsy for lesions < 1 cm regardless of the US appearance unless there are strong clinical risk factors or abnormal cervical lymph nodes. Intermediate risk lesions ≥ 1 cm and low risk lesions ≥1.5 cm generally undergo elective biopsy +/- Endocrinology referral. Current recommendations for very low risk or spongiform lesions with a high likelihood of benignity (>97%) suggest clinical follow-up in two years. For lesions that do not meet currently accepted size thresholds for biopsy, clinical and US follow-up is generally advised in 1-2 years. Recommendations should take into account results from prior FNA biopsy and/or clinical risk factors (such as a positive family history of medullary thyroid cancer, MEN2 syndrome, radiation exposure, and young age).

SYNOPTIC REPORTING of THYROID ULTRASOUND

In an effort to improve quality and decrease variability of radiology reports, structured thyroid US reporting has been adopted by EFW Radiology. A sample report is included [figure 3].

Figure 3: EFW SAMPLE REPORT

CLINICAL HISTORY: Following nodule in the right lobe.

COMPARISON: Prior thyroid US from April, 2016.

FINDINGS:

Thyroid gland dimensions:
R lobe = 5.6 x 1.5 x 1.6 cm, volume 6.99ml; L lobe = 5.9 x 1.3 x 1.4 cm, volume 5.58ml.

Thyroid parenchyma:
Heterogeneous echotexture and normal vascularity.

Thyroid nodules:

Unique Identifier

Volume Change

Risk category

Right lobe: Nodules present.
Right nodule 1 (RN1): Upper, anterior 1.2 cm x 0.9 cm x 0.9 cm; 0.51ml. (+50.0%) ATA risk: intermediate suspicion (10 – 20%).
Solid (< 10% cystic), oval, circumscribed, mildly hypoechoic, no calcifications.
13/04/2016: 0.9 cm x 0.8 cm x 0.9 cm; 0.34ml.

Left lobe: No nodules.

Isthmus: No nodules.

ETA category

Nodal Level

Lymph nodes:
Left lymph node 1: Level II. 2.2 cm x 1.5 cm x 1.2 cm; 2.06ml. ETA classification: suspicious.
Cystic and abnormal peripheral vascularity.

Impression:

RN1 is considered an ATA intermediate risk lesion. This meets size criteria for which elective FNA biopsy and/or endocrinology referral is suggested.
RADIOLOGIST SIGNATURE

Abbreviations:
*ATA = American Thyroid Association; AACE = American Association of Clinical Endocrinologists; AME = Associazione Medici Endocrinologi
** = *The standardized thyroid ultrasound reporting system was developed as a collaboration between EFW Radiology and the University of Calgary Division of Endocrinology (consultation for your patients is available at RRDTC or TBCC through Endocrinology Central Triage ph.# 403-955-8633 fax#: 403-955-8634).*

THYROID ULTRASOUND SUMMARY:

- Thyroid nodules are very common and often discovered incidentally;
- Thyroid US is used to characterize nodules with regard to sonographic malignancy criteria, size, volume, and interval growth/regression;
- Sonographic malignancy criteria are more important than size and growth in determining malignant risk;
- Proper sonographic malignancy risk assessment and risk stratified (de-escalated) treatment strategies are aimed at reducing overdiagnosis and overtreatment;
- EFW is working in collaboration with the University of Calgary Division of Endocrinology to promote improved Thyroid Nodule Malignancy Risk Assessment.

Reference Articles:

1. Mortensen JD, Woolner LB, Bennett WA. Gross and microscopic findings in clinically normal thyroid glands. J Clin Endocrinol Metab 1955;15:1270-80.
2. Ahmed S, Horton KM, Jeffrey RB Jr, Sheth S, Fishman EK. Incidental thyroid nodules on chest CT: review of the literature and management suggestions. AJR Am J Roentgenol 2010;195:1066-71.
3. Youserm DM, Huang T, Loevner LA, Langlotz CP. Clinical and economic impact of incidental thyroid lesions found with CT and MR. AJNR Am J Neuroradiol 1997;18:1423-8.
4. Nguyen XV, Choudhury KR, Eastwood JD, et al. Incidental thyroid nodules on CT: evaluation of 2 risk-categorization methods for workup of nodules. AJNR Am J Neuroradiol 2013;34:1812-9. Soelberg KK, Bonnema SJ, Brix TH, Hegedus L. Risk of malignancy in thyroid incidentalomas detected by 18F-fluorodeoxyglucose PET: a systematic review. Thyroid 2012;22:918-25.
5. Ezzat S, Sarti DA, Cain DR, Braunstein GD. Thyroid incidentalomas. Prevalence by palpation and ultrasonography. Arch Intern Med 1994;154:1838-40.
6. Rad M, Zakavi S, Layegh P, Khooei A, Bahadori A. Incidental thyroid abnormalities on carotid color doppler ultrasound: frequency and clinical significance. J Med Ultrasound 2014. Published ahead of print on June 3, 2014.
7. Shie P, Cardarelli R, Sprawls K, Fulda KG, Taur A. Systematic review: prevalence of malignant incidental thyroid nodules identified on fluorine18 fluorodeoxyglucose PET. Nucl Med Commun 2009;30:742-8.
8. Shetty SK, Maher MM, Hahn PF, Halpern EF, Aquino SL: Significance of incidental thyroid lesions detected on CT: correlation among CT, sonography, and pathology. AJR Am J Roentgenol 2006; 187: 1349–1356.
9. Leenhardt L, Hejblum G, Franc B, Fediaevsky LD, Delbot T, Le Guillouzic D, Menegaux F, Guillausseau C, Hoang C, Turpin G, Aurengo A: Indications and limits of ultrasound-guided cytology in the management of nonpalpable thyroid nodules. J Clin Endocrinol Metab 1999; 84: 24–28.
10. Soelberg KK, Bonnema SJ, Brix TH, Hegedus L: Risk of malignancy in thyroid incidentalomas detected by 18F-fluorodeoxyglucose positron emission tomography: a systematic review. Thyroid 2012; 22: 918–925.
11. Davies L, Welch HG 2014 Current thyroid cancer trends in the United States. JAMA Otolaryngol Head Neck Surg 140:317–322.
12. Ahn HS, Kim HJ, Welch HG. Korea's thyroid-cancer" epidemic"--screening and overdiagnosis. The New England journal of medicine. 2014 Nov 6;371(19):1765.
13. Vaccarella S, Franceschi S, Bray F, Wild CP, Plummer M, Dal Maso L. Worldwide Thyroid-cancer Epidemic? The Increasing Impact of Overdiagnosis. The New England journal of medicine. 2016 Aug 18;375(7):614-7.
14. Haugen BR, Alexander EK, Bible KC, Doherty GM, Mandel SJ, Nikiforov YE, Pacini F, Randolph GW, Sawka AM, Schlumberger M, Schuff KG, Sherman SI, Sosa JA, Steward DL, Tuttle RM, Wartofsky L: 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.
15. Kwak JY, Han KH, Yoon JH, Moon HJ, Son EJ, Park SH, Jung HK, Choi JS, Kim BM, Kim EK 2011 Thyroid imaging reporting and data system for US features of nodules: a step in establishing better stratification of cancer risk. Radiology 260:892–899.
16. Salmaslioglu A, Erbil Y, Dural C, Issever H, Kapran Y, Ozarmagan S, Tezelman S 2008 Predictive value of sonographic features in preoperative evaluation of malignant thyroid nodules in a multinodular goiter. World J Surg 32:1948–1954.
17. Gul K, Ersoy R, Dirikoc A, Korukluoglu B, Ersoy PE, Aydin R, Ugras SN, Belenli OK, akir B 2009 Ultrasonographic evaluation of thyroid nodules: comparison of ultrasonographic, cytological, and histopathological findings. Endocrine 36:464–472.
18. Frates MC, Benson CB, Doubilet PM, Kunreuther E,Contreras M, Cibas ES, Orcutt J, Moore FD Jr, Larsen PR, Marqusee E, Alexander EK 2006 Prevalence and distribution of carcinoma in patients with solitary and multiple thyroid nodules on sonography. J Clin Endocrinol Metab 91:3411–3417.
19. Nam-Goong IS, Kim HY, Gong G, Lee HK, Hong SJ, Kim WB, Shong YK 2004 Ultrasonography-guided fineneedle aspiration of thyroid incidentaloma: correlation with pathological findings. Clin Endocrinol (Oxf) 60: 21–28.
20. Henrichsen TL, Reading CC, Charboneau JW, Donovan DJ, Sebo TJ, Hay ID 2010 Cystic change in thyroid carcinoma: prevalence and estimated volume in 360 carcinomas. J Clin Ultrasound 38:361–366.
21. Jung Hee Shin, Jung Hwan Baek, Jin Chung, Eun Ju Ha, et al. Ultrasound Diagnosis and Imaging-Based Management of Thyroid Nodules: Revised Korean Society of Thyroid Radiology Consensus Statement and Guidelines. Korean Journal of Radiology 2016; 17 (3): 370-95.
22. Na DG, Baek JH, Sung JY, Kim JH, Kim JK, Choi YJ, et al. Thyroid imaging reporting and data system risk stratification of thyroid nodules: categorization based on solidity and echogenicity. Thyroid 2016;26:562-572.
23. Moon WJ, Jung SL, Lee JH, Na DG, Baek JH, Lee YH, et al. Benign and malignant thyroid nodules: US differentiation--multicenter retrospective study. Radiology 2008;247:762-770.
24. Kwak JY, Jung I, Baek JH, Baek SM, Choi N, Choi YJ, et al. Image reporting and characterization system for ultrasound features of thyroid nodules: multicentric Korean retrospective study. Korean J Radiol 2013;14:110-117
25. Gharib H, Papini E, Garber J, Duick D, Harrell RM, et al. 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. Thyroid Nodule Management, Endocr Pract. 2016;22(Suppl 1).
26. Brauer VFH, Eder P, Miehle K, Wiesner TD, Hasenclever H, Pashcke R. Interobserver Variation for Ultrasound Determination of Thyroid Nodule Volumes. Thyroid 2005; Volume 14, Number 10, 1169-75.
27. Lamartina L, Deandreis D, Durante C, Filetti S. Imaging in the follow-up of differentiated thyroid cancer: current evidence and future perspectives for a risk-adapted approach. European Journal of Endocrinology (2016) 175, R185–R202