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Editorial: Contemporary Approach to Thyroid Nodules

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Abbreviation

AI (Artificial intelligence) ,

FNAB(Fine Needle Aspiration Biopsy),

CEUS (contrast-enhanced ultrasound),

TI-RADS(Thyroid Imaging Reporting and Data System),

Thyroid nodules are a widespread clinical entity estimated to affect up to 60% of adults. While the majority of these nodules are benign, the potential for malignancy, though low, at around 5%—drives the importance of careful evaluation and management protocols; the risk of a malignant thyroid nodule increases with size. Researchers suggest that nodules measuring 3–5.9 cm have a 26% higher malignancy risk than those smaller than 3 cm. Ironically, larger than 6 cm may have a lower malignancy risk (1).

Most thyroid nodules are benign, and most remain benign. Moreover, the malignant nodules are primarily of small low risk and seldom progress; on the other hand, sometimes unnecessary diagnostic evaluation and unnecessary thyroidectomies have a very negative impact on a patient's life(2).

In the past, the only way to identify thyroid malignancy was thyroidectomy, and even surgeons were called horrible butchers who performed thyroidectomy. With the development of ultrasound in health care in the 1960s, it was used in thyroid nodules for risk stratification. From the 1980s,

FNAB and cytopathology started to be used in thyroid nodule evaluation for thyroid malignancy(3).

High-resolution ultrasound and fine-needle aspiration biopsy are the best, most reliable, standardized tools for evaluating thyroid nodules.

Three famous ultrasound reporting systems currently prevail.

1) the 2015 American Thyroid Association (ATA).

(2) 2016 American Association of Clinical Endocrinology, (AACE), American College of Endocrinology (ACE), and Associazione Medici Endocrinologi (AME) .

(3) The 2017 American College of Radiology (ACR) Thyroid Imaging Reporting and Data System (TI-RADS) is more commonly used in the MENA region and Gulf countries.

There are some differences between the reporting systems beyond the scope of this editorial. The overall goal of these different systems is to reduce the rate of Biopsies of benign nodules. The ATA and ACR TIRADSs do not advise FNA of nodules measuring <1.0 cm because of their low risk of progression to malignancy, whereas the AACE recommends FNA if these small nodules rapidly grow.

Fine Needle Aspiration with Bethesda System for Reporting Thyroid Cytopathology

From its first appearance in 2010 to its most recent edition in 2023, The Bethesda System for Reporting Thyroid Cytopathology has allowed for the standardization of thyroid FNA cytology as follows: Nondiagnostic, benign, atypia of undetermined significance follicular neoplasm, suspicious of Malignancy and Malignant. A third tool is molecular genetic markers, which can be beneficial from atypia of undetermined significance, which represent almost 25 % of FNAB results, plus 60% of thyroid malignancies have some somatic mutation (3).

Current guidelines recommend fine-needle aspiration biopsy for nodules greater than 1 cm with suspicious features. These features include irregular margins, microcalcifications, and taller-than-wide shapes (4).

Other tools that have not yet been standardized include contrast-enhanced ultrasound integrated with conventional ultrasound to differentiate ACR TI-RADS category 4 and 5 nodules from non-hypo vascular; contrast-enhanced ultrasound improves the validity of conventional ultrasound by allowing healthcare providers to observe the dynamic enhancement patterns of thyroid nodules after injection of a contrast agent; other studies observe that hypo-enhancement (reduced enhancement compared to surrounding tissue is a strong indicator of malignancy, showing sensitivity and specificity rates around 82% and 85%, respectively(5).

Another tool not yet established is ultrasound elastography of the thyroid, which is easily integrated into the conventional US and can help differentiate benign from malignant nodules. It relies on hard nodules and is more likely to be malignant. It is like electronic palpitation(6) .

The American Thyroid Association recommends incorporating elastography into the evaluation process for thyroid nodules, especially those with indeterminate characteristics on gray-scale

ultrasound. It serves as a complementary tool rather than a replacement for traditional imaging techniques (7).

Emerging Artificial intelligence for thyroid nodules has started to be used, and many commercially available products are in the literature. It is now available in commercially available FDA-approved products. Several studies suggest a performance increase for thyroid nodules from a combined radiologist-plus-AI approach (8).

Fine-needle aspiration cytology is fundamental for diagnosing thyroid nodules. Artificial intelligence applications like machine learning and deep learning have emerged in thyroid cytology and radiology to improve diagnostic accuracy and avoid unnecessary biopsies or surgeries (9).

AI's application in thyroid ultrasound mainly focuses on Improving Diagnostic Accuracy. AI algorithms can run complex imaging data more efficiently than conventional methods, helping radiologists achieve more accurate diagnoses while reducing their workload; the second focus is supporting the Clinical Decision-making process as it serves as a supplementary tool, providing second opinions, especially in facilities with limited specialist expertise (10).

The rising incidence of thyroid nodules imposes significant economic burdens on healthcare systems in most countries due to costs related to diagnostic evaluations and treatments. In the Ultrasound ., well-differentiated thyroid cancer care expenditures are projected to exceed $3.5 billion by 2030, highlighting the financial burden of both benign and malignant cases (11).

Conclusion

Thyroid nodule evaluation is a complex interplay between evaluating malignancy risks and avoiding over diagnosing benign conditions. As imaging technology advances and more sensitive diagnostic tools become available, healthcare providers must conduct balanced, thorough evaluations to prevent unnecessary interventions. Ongoing research into optimal management strategies will be essential in refining approaches to this common, prevalent clinical entity.

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