Review

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Visualizing thyroid health: a pictorial journey through 2017 ACR TI-RADS and common thyroid pathologies

Prajwal Dahal, MD[a,*], Sabina Parajuli, MBBS[b], Prajina Pradhan, MD[a]

Abstract

With the advent of high-resolution ultrasonography (HRUS), more thyroid nodules are being detected than ever before, and they are being identified at an earlier stage. It poses a challenge for radiologists and clinicians in deciding what to do next. Most nodules are benign and require no follow-up and intervention. Even highly suspicious nodules can be followed up, if the size is small. Variations in HRUS interpretation among radiologists are common, with frequent misidentifications between spongiform and solid-cystic lesions, hypoechoic and very hypoechoic nodules, and microcalcification and hyperechoic foci with comet-tail artifacts. Cystic lesions with echogenic contents are often confused with solid nodules, cystic papillary carcinoma thyroid is often confused with colloid cysts. The 2017 ACR TI-RADS (American College of Radiology Thyroid Imaging Reporting and Data System) aims to standardize the interpretation of thyroid nodules and guide further management. Rather than giving specific diagnosis like colloid cyst, adenomatous nodule and papillary carcinoma; ACR TI-RADS classifies nodules from TI-RADS 1 to TI-RADS 5 based on HRUS characteristics and recommends further management. What the authors often read are textual contents that are theoretical, and in practice, the authors get confused while interpreting the characteristics of thyroid nodules. This review offers a detailed visual overview of the 2017 ACR TI-RADS and common thyroid conditions, explaining key features through imaging data and examples for consistent interpretation. Combining textual explanations with visual aids, this article provides practical guidance for interpreting thyroid nodules for radiologists, and clinicians seeking a clear understanding of thyroid imaging and pathology.

Keywords: malignant, thyroid nodule, thyroiditis, ultrasonography

Introduction

The prevalence of thyroid nodules is up to 68% in adults in ultrasonography (US)[1]. US is readily available, radiation-free, and is the modality of choice for screening the thyroid gland[2]. Currently, fine-needle aspiration cytology (FNAC) is the gold standard for evaluating the nature of thyroid nodules[3]. Most thyroid nodules are benign. Even the malignant ones with a size less than a centimeter are indolent and do not require FNAC[4]. Despite the rise in the incidence of detection of thyroid malignancies due to US, mortality remains significantly low, especially for lesions of subcentimetric size[5]. The 2017 American College of Radiology Thyroid Imaging and Reporting Data System (ACR TI-RADS) is a US-based risk stratification system that helps in evaluating risk of malignancy of thyroid nodules, standardizes the reporting, reduces unnecessary FNAC procedures, and provides guidelines for follow-up[4].

The objective of this review is to aid healthcare providers, especially radiologists and clinicians, in diagnosing thyroid disorders by providing a visual reference. It aims to correctly stratify nodules based on the 2017 ACR TI-RADS lexicon and familiarize readers with a few commonly encountered thyroid pathologies through high-resolution US images. The pictures used in this review are based on cases evaluated by the authors from January

HIGHLIGHTS

- Thyroid nodules are frequently encountered in clinical practice and imaging.
- Management of thyroid nodules depends on whether they are benign or malignant.
- The interpretation of thyroid nodules in imaging and assessing their risk of malignancy is subject to variation among radiologists.
- The 2017 ACR TI-RADS guides radiologists in interpreting the imaging findings in thyroid nodules, ensuring precise and consistent interpretation of thyroid imaging studies.
- Adenomatous nodule and colloid cyst are common benign lesions. Papillary carcinoma and follicular neoplasms are commonly encountered malignant lesion.

[a]Department of Radiology and Imaging, Grande International Hospital and [b]Department of Pathology, Bir Hospital, Kathmandu, Nepal

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*Corresponding authors. Address: Grande International Hospital, Tokha Road, Kathmandu, Bagmati, Nepal. Tel.: +977 984 194 8177. E-mail: meprajwal7@gmail.com (P. Dahal).

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2022 to December 2023 over a two-year period at a private tertiary center in Kathmandu. The pictures depict individuals of all genders and ethnicities aged 13–90 years. The histopathological diagnosis is considered the final diagnosis. The US was conducted in a Toshiba Aplio 300 machine with a PLT-705 BT linear probe by the principal author.

Features evaluated in 2017 ACR TI-RADS

In the 2017 ACR TI-RADS system, the US features of thyroid nodules are evaluated based on the following features, with points allocated for each feature. The total score is obtained by adding up all the points, and the lesion is categorized from TI-RADS 1–5 based on the total score obtained; TI-RADS 1 being a benign lesion and TI-RADS 5 being highly suspicious form malignancy[4]. The decision for FNAC and follow-up is made based on the category and size of the lesions.

Composition (Fig. 1)

The composition of the lesion depends on the content, whether completely fluid or soft tissue or both. The lesion is classified as follows:

Cystic or almost completely cystic (Fig. 1a): The content is completely fluid. This is a benign characteristic in US.

Spongiform (Fig. 1b): A lesion is considered spongiform when multiple small cystic spaces occupy more than 50% of the total volume and provide sponge-like look[6]. This is also a benign characteristic.

Mixed cystic and solid (Fig. 1c): A lesion is considered mixed solid and cystic when less than 50% of the volume is filled with fluid. This is an intermediate characteristic. If the solid component is eccentric and makes an acute angle with a wall of the lesion, has features like irregular or lobulated margin and microcalcifications, it is suspicious for malignancy.

Solid or almost completely solid (Fig. 1d): A lesion is considered solid when nearly 100% of the volume of the lesion is soft tissue. This is one of the features of malignancy. If the composition of the lesion cannot be determined due to calcification, the lesion should be considered solid for scoring.

Echogenicity (Fig. 2)

While determining the echogenicity of a lesion, only a solid component is taken into account. Echogenicity of a thyroid nodule is compared to the normal thyroid parenchyma or surrounding cervical muscles. Thyroid nodules can be:

Anechoic (Fig. 2a): Cystic lesions are anechoic. This is a benign characteristic in US.

Hyperechoic (Fig. 2b) or isoechoic (Fig. 2c): The lesions with echogenicity more than thyroid parenchyma are considered hyperechoic. The lesions with echogenicity similar to thyroid parenchyma are considered isoechoic. If the echogenicity of a lesion cannot be determined, it should be considered isoechoic for scoring.

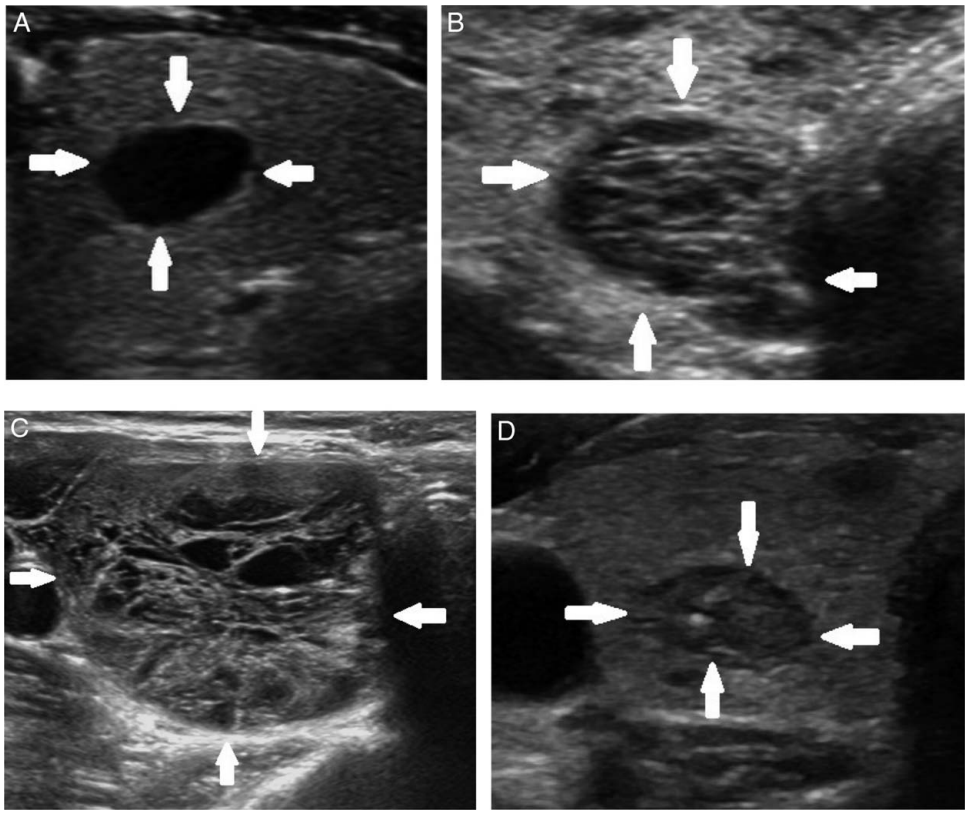

Figure 1. (A–D) Show US pictures of completely cystic, spongiform, mixed solid-cystic and solid lesions respectively. No point is given for cystic and spongiform lesions. Mixed solid and cystic and solid lesions are given 1 and 2 points, respectively.

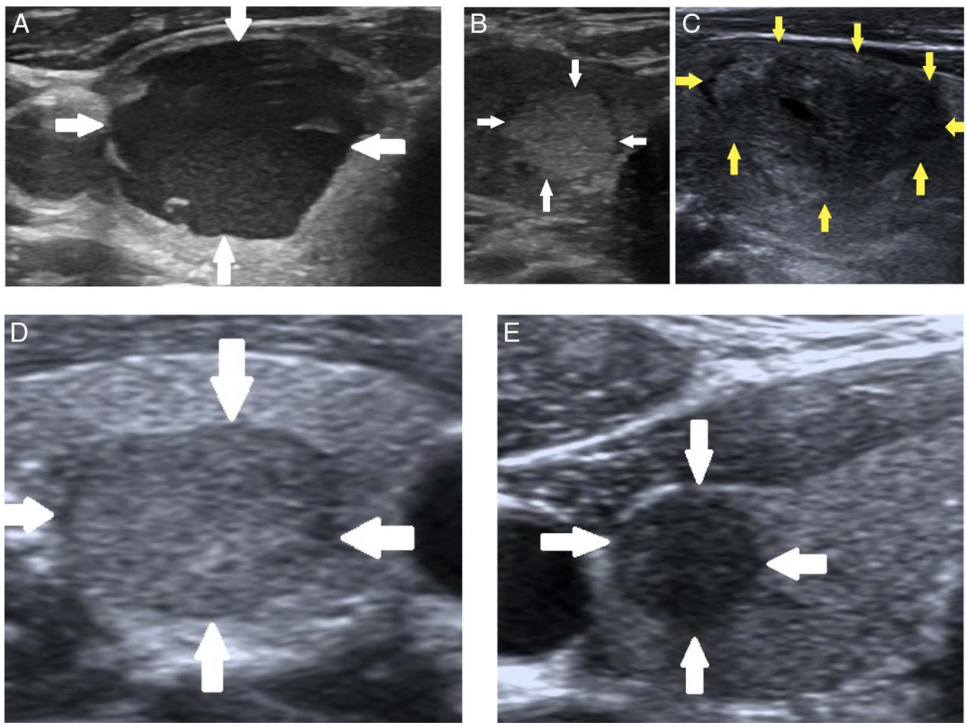

Figure 2. (A–E) Show US images of anechoic, hyperechoic, isoechoic, hypoechoic and very hypoechoic lesions respectively. No point is given for anechoic lesion. Hyperechoic and isoechoic lesions get 1 point. Hypoechoic and very hypoechoic lesions get 2 and 3 points, respectively.

Hypoechoic (Fig. 2d): The lesion with echogenicity less than normal thyroid tissue is considered hypoechoic. Hypoechogenicity is a feature of malignancy.

Very hypoechoic (Fig. 2e): The lesion with echogenicity less than the cervical muscles is considered hypoechoic. Hypoechogenicity is very specific for malignancy.

Shape (Fig. 3)

The shape of a lesion should be evaluated in the axial plane. The width and height of the lesion should be measured in a manner parallel to sound beams for height and perpendicular to the sound beam for width.

Wider-than-tall (Fig. 3a): If the width of a lesion is more than height, it is considered a benign characteristic.

Taller-than-wide (Fig. 3b): If the height of a lesion is more than width, it is considered a characteristic of malignancy with high specificity.

Margin (Fig. 4)

Margin is the interface of the lesion with thyroid or extra thyroid tissue.

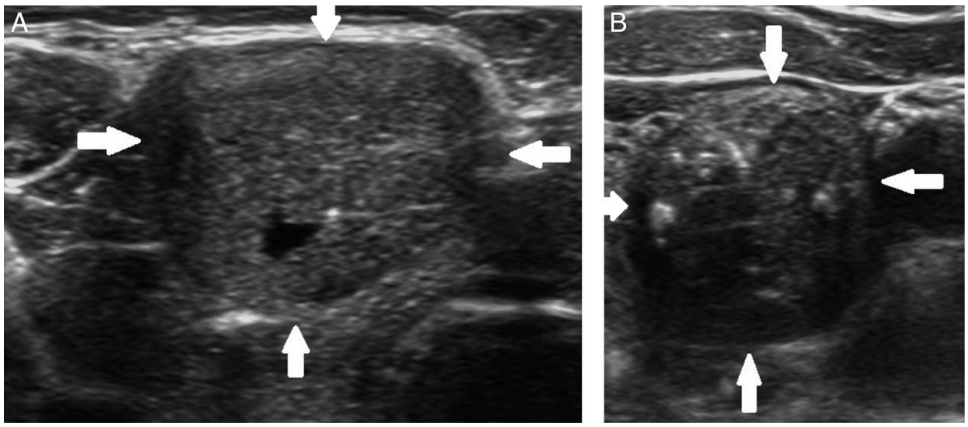

Figure 3. (A and B) Show US images of wider-than-taller and taller-than-wider lesions, respectively. No point is given for wider-than-tall lesion whereas taller-than-wide lesion gets 3 points.

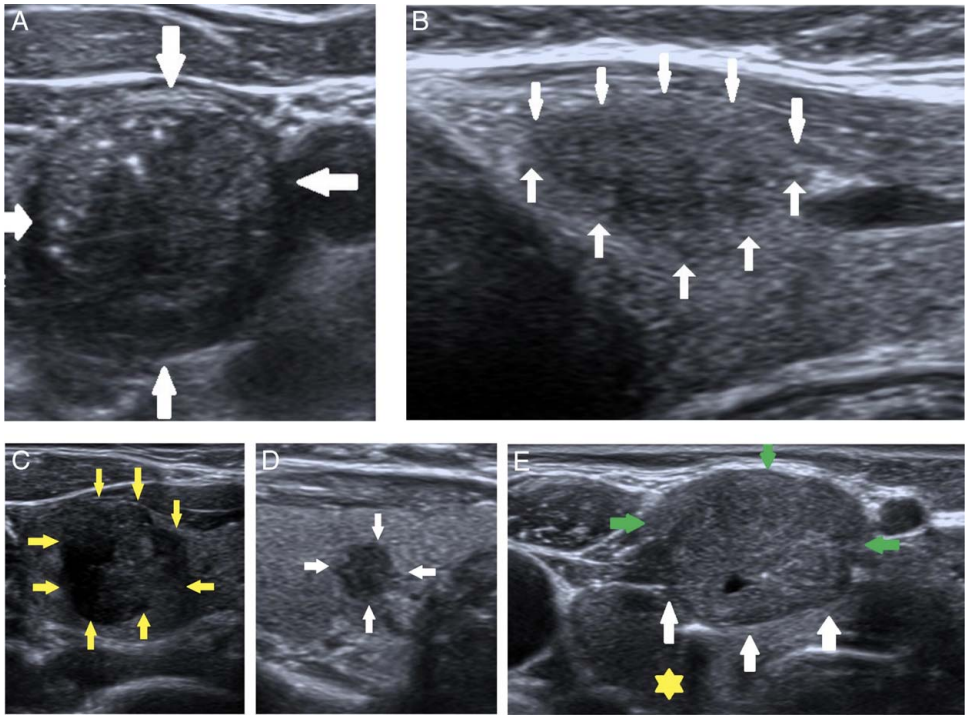

Figure 4. (A–D) Show US images of lesions with smooth, ill-defined, lobulated and irregular margins, respectively. (E) Shows a lesion with extra thyroid extension. No points are given for smooth and ill-defined lesions. Lobulated and irregular lesions get 2 points. Lesions with extra thyroid extension get 3 points.

Smooth (Fig. 4a): A well-defined, uninterrupted, curved interface is a smooth margin. It is a feature of benign lesion.

Ill-defined (Fig. 4b): If the interface between the lesion and surrounding tissue cannot be clearly delineated, the margin of the lesion is considered ill-defined. It is a feature of benign lesions.

Lobulated (Fig. 4c) or irregular (Fig. 4d): A lobulated margin refers to a wavy edge or boundary of a lesion giving the appearance of distinct lobes or rounded protrusions. If the interface between the lesion and thyroid tissue or extra thyroid tissue is jagged or spiculated with acute angles at the interface, the margin is considered irregular. It is a feature of malignant lesions.

Extrathyroidal extension (Fig. 4e): If the lesion extends beyond the margin of the thyroid gland invading the adjacent soft tissue or blood vessels, it is considered extrathyroidal extension. Extrathyroidal extension is a sign of malignancy and has a poor prognosis. **In**Figure 4e, extrathyroidal extension is shown by the white arrow.

Echogenic foci in the lesion (Fig. 5)

Echogenic foci, defined as focal area of high echogenicity are often seen in thyroid nodules. These foci range from tiny echogenic foci showing posterior comet-tail artifacts to macrocalcifications.

None or large comet-tail artifacts (Fig. 5a): Presence of echogenic foci with comet-tail artifacts or absence of any echogenic foci are features of a benign nodule. Comet-tail artifacts are the reverberation artifacts caused by strongly reflective colloid crystals.

Macrocalcifications (Fig. 5b): Hyperechoic foci, large enough to cast posterior acoustic shadow are considered as macrocalcification. It is the feature of an intermediate lesion.

Peripheral(rim) calcifications (Fig. 5c): Hyperechoic foci casting posterior acoustic shadow are seen in the margin of the lesion. These foci may be continuous or interrupted and partially or completely obscure the contents inside the lesion. It is the feature of malignancy.

Punctate echogenic foci/ microcalcifications (Fig. 5d): Tiny echogenic foci not casting posterior acoustic shadow are microcalcifications. They corroborate with psammomatous calcification of papillary carcinoma. These are highly specific for malignancy. Microcalcifications should not be confused with reverberation artifacts.

The points assigned for each sonographic feature is listed in Table 1.

FNAC and follow-up

The points obtained in all above-mentioned categories are added and the total TI-RADS point is calculated. The probability of malignancy in a nodule based on total TI-RADS points and recommendation for follow-up is summarized in Table 2. If there is no change in size during the 5-year period, imaging can be stopped, as stability within this timeframe reliably indicates a benign nature of the nodule[4]. If size of the nodule increases, next follow-up should be after 1 year. In 2017 ACR TI-RADS, significant enlargement is defined as a 20% increase in at least two nodule dimensions and a minimal increase of 2 mm or 50% or greater increase in volume during follow-up scan[4]. If there is a significant increase in size and the size criteria are met, FNAC is to

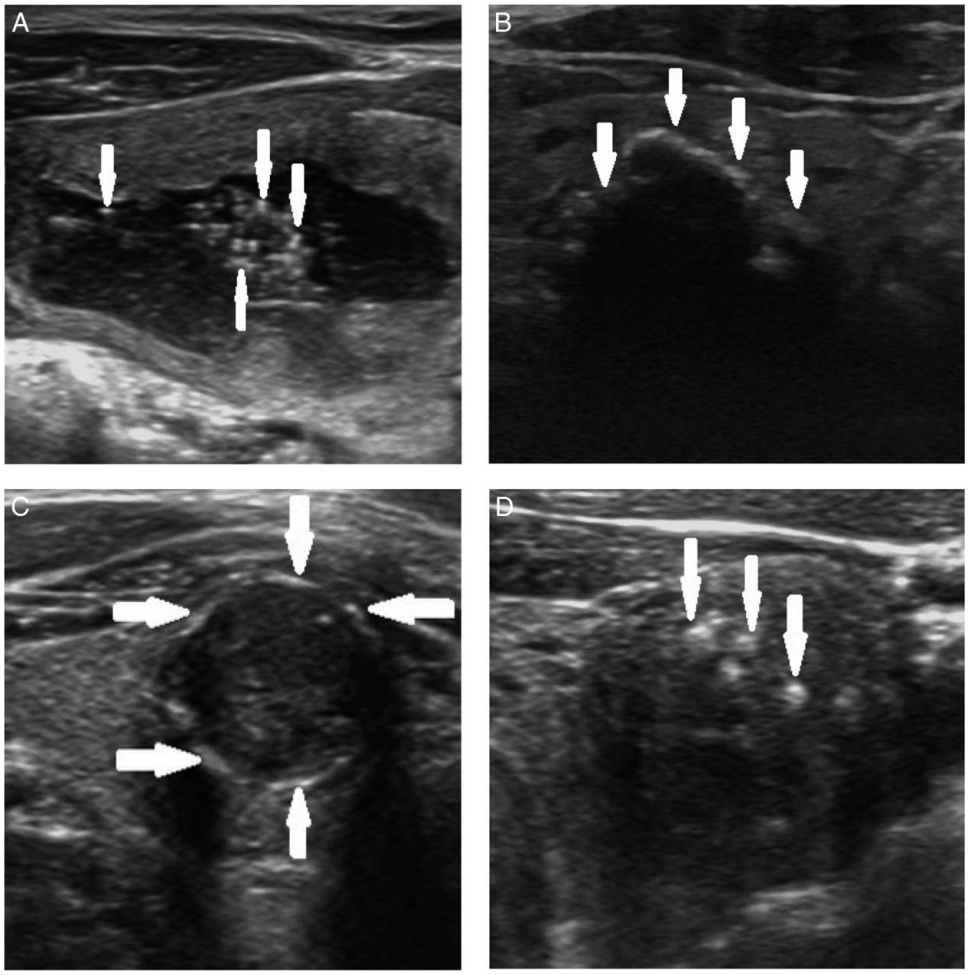

Figure 5. (A–D) Show US images of lesions with echogenic foci showing comet-tail artifacts, macrocalcification, peripheral calcification and microcalcification, respectively. Lesions with echogenic foci show comet-tail artifacts gets no point. Lesions with macrocalcification, peripheral calcification and microcalcification get 1, 2 and 3 points, respectively.

be done at follow-up. If size criteria are not met, follow-up at 1 year should be done[4]. If there are multiple nodules, FNAC from not more than two nodules with the highest TI-RADS value is recommended[4]. Assessment of cervical lymph nodes is a vital part of examination. Abnormal findings include an increase in size, necrosis with loss of fatty hilum, absence of hilar/central vascularity and microcalcifications. FNAC of suspicious lymph nodes is recommended[4].

Discussion

Thyroid is one of the few organs which is best evaluated by US than any other modalities. 2017 ACR TI-RADS thus helps in the stratification of risk of malignancy in any thyroid nodule, standardizes the reporting and avoid unnecessary FNACs. Internal vascularity of the lesion does not determine whether the lesion is benign or malignant. However, it helps to distinguish between debris and solid components in a lesion[7]. Debris can be distinguished by layering and motion during change in position. Perilesional hypoechoic halo is often seen in adenomatous nodules[6]. This characteristic does not define the benign or malignant nature of the nodules, and hence this is not incorporated in lexicon and scoring. Echogenic foci showing comet-tail artifacts and hypoechogenicity of wall of spongiform nodules should not be confused with microcalcification[8]. Diffusely hyperechoic of variegated hyperechoic areas separated by hypoechoic bands are suggestive of a benign pattern of thyroiditis[9]. A hyperechoic nodule has a higher malignancy potential than an isoechoic nodule[10]. But, in 2017 ACR TI-RADS, same point is given for both. If a nodule is abutting trachea-esophageal grove (site of the recurrent laryngeal nerve) or trachea, it should be reported[4]. Measurement in all three dimensions is recommended. Further improvements can be made in 2017 ACR TI-RADS[11]. In resource-poor setting where compliance of follow-up is poor, threshold for FNAC should be less than the current recommendation. Another potential improvement would be including nodule location in the evaluation and assign less points to microcalcification in solid-cystic lesion[8]. Elastography and contrast-enhanced US can be incorporated in the future. Artificial intelligence might be useful in the future in evaluating thyroid nodules[8].

Table 1

Points given to each sonographic feature according to American College of Radiology Thyroid Imaging Reporting and Data System (TI-RADS) 2017[4].

Sonographic features	Points
Composition	
Cystic or almost completely cystic	0
Spongiform	0
Mixed solid and cystic	1
Solid or near completely solid	2
Echogenicity	
Anechoic	0
Hyperechoic or isoechoic	1
Hypoechoic	2
Very hypoechoic	3
Shape	
Wider than tall	0
Taller than wide	3
Margin	
Smooth	0
Ill-defined	0
Lobulated or irregular	2
Extrathyroidal extension	3
Echogenic foci	
None or large comet-tail artifacts	0
Macrocalcifications	1
Peripheral (rim) calcifications	2
Punctate echogenic foci	3

Commonly encountered thyroid nodules and their TI-RADS categorization

Hyperplastic nodule/ adenomatous nodule/ colloid nodule

The nodules mentioned are benign and typically associated with a follicular growth pattern triggered by iodine deficiency, hormogenesis disorders, and inefficient iodine utilization[12]. In US, these nodules appear as spongiform nodules or solid nodules that are isoechoic to hyperechoic in comparison to the surrounding thyroid tissue[2]. In solid isoechoic/hyperechoic lesions, a peripheral hypoechoic halo may be present, indicating peripheral vessels and edema caused by compression of normal thyroid tissue. Additionally, coarse nodular or peripheral calcifications might be observed, and the lesion may exhibit peripheral vascularity[6].

Spongiform nodules are characterized by multiple tiny cystic spaces within, occupying more than 50% of the nodule's volume[13]. These cystic spaces result from liquefactive degeneration of the solid component. Figure 6 illustrates an adenomatous and colloid nodule confirmed by fine-needle aspiration cytology (FNAC). In Figure 6a and b, a solid lesion with smooth margins, isoechoic appearance, and a wider-than-taller shape is observed. Mild peripheral vascularity and a smooth perilesional hypoechoic halo are also visible. This lesion should be categorized as TI-RADS category 3. In Figure 6c, a lesion with smooth margins, a spongiform appearance, and a wider-than-taller shape is observed. This lesion should be categorized as TI-RADS category 1.

Colloid Cysts

These lesions are benign in nature, with the majority being entirely cystic, while a few contain debris. Echogenic foci displaying comet-tail artifacts are commonly observed within these lesions. Some lesions may have inspissated contents, giving them a pseudo-solid appearance. Colloid cysts result from the liquefactive degeneration of colloid nodules[14]. Figure 7 illustrates a lesion that is entirely cystic and contains echogenic foci displaying comet-tail artifacts. This type of lesion, known as a colloid cyst, falls into the TI-RADS category 1 classification due to its benign nature.

Multinodular goiter

Multinodular goiter is benign enlargement of thyroid gland with multiple benign nodules of varying sizes. The nodules range from colloid cysts or colloid nodules[15].

Follicular adenoma/ follicular carcinoma

Follicular adenomas account for 5–10% of thyroid nodules and are more prevalent in females[16]. They are genuine neoplasms and can be challenging to distinguish from follicular carcinomas. Follicular adenomas have a true fibrous capsule and compress the surrounding normal thyroid tissue. Types of follicular adenomas include fetal adenoma, Hurthle cell adenoma, and embryonal adenoma[16].

The differentiation between follicular adenoma and carcinoma primarily occurs at the histological level, not in cytology. The key distinction lies in the invasion of the fibrous capsule and surrounding vessels in follicular carcinoma[17]. Follicular carcinomas spread hematogeneously. In US, adenomas appear as solid nodules and can be hypoechoic, isoechoic, or hyperechoic. Isoechoic and hyperechoic lesions usually exhibit a perilesional halo, indicating surrounding vessels and the fibrous capsule[16]. On color Doppler, peripheral vascularity is common, and vessels

Table 2

Probability of benignity/malignancy of a nodule based on total TI-RADS points and recommendation for follow-up[4].

Total TI-RADS points	TI-RADS category	Probability of benignity/malignancy of a nodule	Recommendation
0–1	TI-RADS 1	Benign	No FNAC required
2	TI-RADS 2	Not suspicious	No FNAC required
3	TI-RADS 3	Mildly suspicious	Size $\geq$1.5 cm: follow-up at 1, 3 and 5 years. Size $\geq$2.5 cm: FNAC
4–6	TI-RADS 4	Moderately suspicious	Size $\geq$1 cm: follow-up at 1, 2, 3 and 5 years. Size $\geq$1.5 cm: FNAC
$\geq$ 7	TI-RADS 5	Highly suspicious	Size $\geq$0.5 cm: follow-up annually up to 5 years. Size $\geq$1 cm: FNAC

FNAC, fine-needle aspiration cytology; TI-RADS, Thyroid Imaging Reporting and Data System.

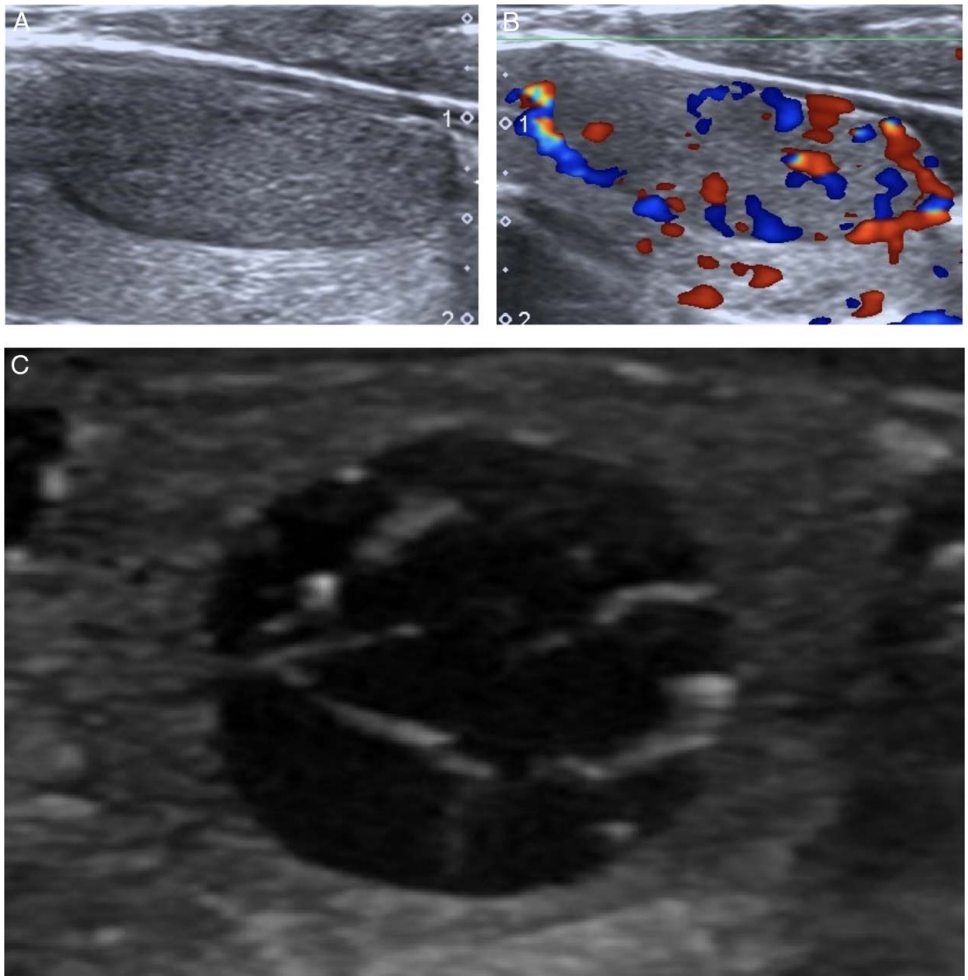

Figure 6. (A and B) Show US image of adenomatous nodule. It should be categorized as TI-RADS category 3 lesion. (C) Shows US image of a colloid nodule. It should be categorized as TI-RADS category 1 lesion.

often pass from the periphery to the center, creating a "spoke and wheel" pattern.

The presence of irregular or lobular margins, a thick and irregular perilesional halo, and disorganized internal vascularity suggest a breach in the capsule by the lesion, indicating the possibility of follicular carcinoma[17]. Figure 8 shows US images of histologically confirmed follicular adenoma. Figure 8a shows a smooth-marginated, solid, hyperechoic, wider-than-taller nodule with a peripheral hypoechoic halo. Figure 8b shows spoke-wheel pattern of vascularity on color doppler. This lesion should be categorized as TI-RADS category 3

Medullary carcinoma thyroid

Medullary Carcinoma Thyroid (MCT) accounts for 5–10% of thyroid malignancies and can be either sporadic or familial, often associated with conditions such as multiple endocrine neoplasia type 2 (MEN 2), Von Hippel-Lindau disease, and neurofibromatosis type 1[18]. MCT is a highly aggressive neuroendocrine tumor, posing challenges in differentiation from Papillary Carcinoma Thyroid (PCT) using US alone[19].

In US, MCT appears as a round to oval hypoechoic solid lesion with multiple macro calcific foci and internal vascularity. Advanced cases may show extra-thyroid extension. Mild internal vascularity might be present, and lymph nodal metastasis and local invasion could be evident upon initial presentation[18,19]. Serum calcitonin level serves as a sensitive and specific marker for MCT[19].

Figure 9 illustrates a case of MCT confirmed by FNAC. The lesion appears as a solid, lobulated, hypoechoic, wider-than-taller nodule with multiple calcific foci. Notably, there is mild extra-thyroidal extension of the lesion posteriorly (indicated by the white arrow). This lesion falls into the TI-RADS category 5 classification.

Papillary carcinoma thyroid

Papillary carcinoma thyroid (PCT) stands as the most prevalent malignancy of the thyroid gland, comprising 80–85% of thyroid malignancies[20]. In US, PCT typically manifests as an isoechoic to hypoechoic solid lesion with micro calcific foci. These lesions often exhibit irregular or lobulated shapes and are taller than they are wider. Disorganized internal vascularity characterizes their appearance[20]. A small subset of PCT cases might display a cystic component. In such instances, intra-cystic papillary projections

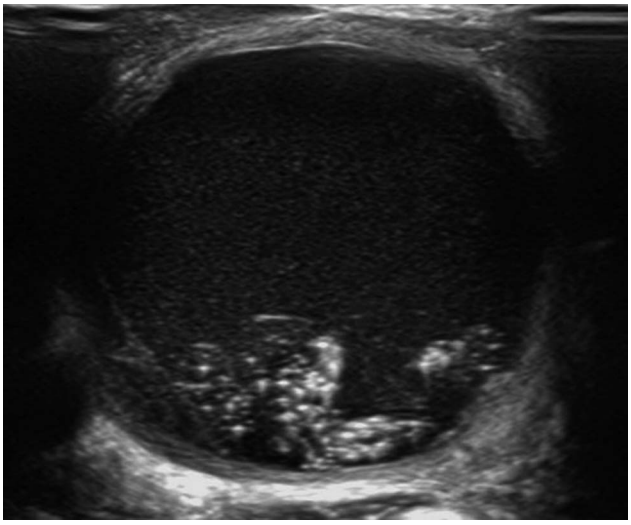

Figure 7. Ultrasonography image of colloid cyst with multiple echogenic foci showing comet-tail artifacts within. It should be categorized as TI-RADS category 1 lesion.

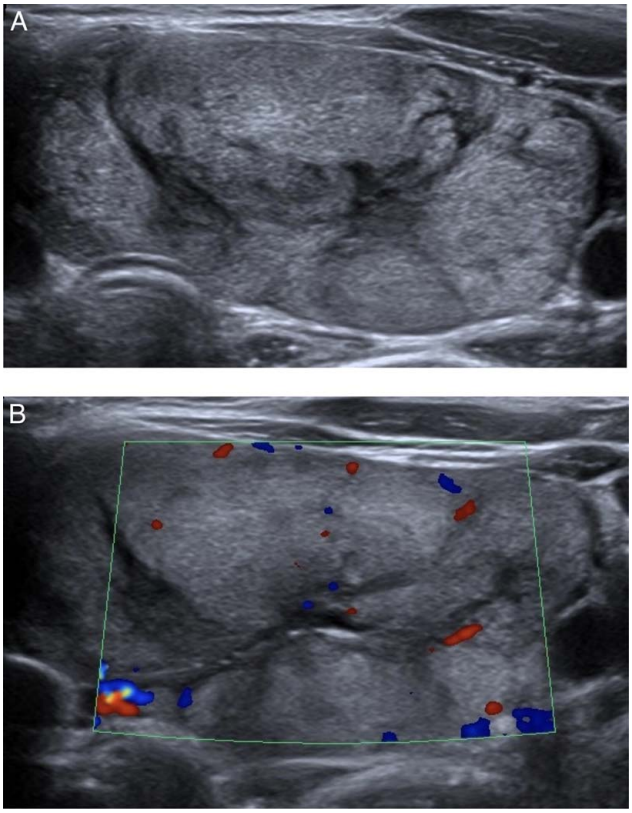

Figure 8. Ultrasonography image of follicular adenoma of thyroid. A smooth-marginated, solid, hyperechoic, wider-than-taller nodule with a peripheral hypoechoic halo and a spoke-wheel pattern of vascularity. This lesion should be categorized as TI-RADS category 3.

with vascularity can be observed using color Doppler imaging[20,21].

It's crucial to assess cervical lymph nodes in suspected PCT cases due to the high prevalence of lymphatic spread. Suspicious lymph nodes appear enlarged, exhibit necrosis, or contain micro calcific foci. Additionally, they lose their fatty hilum, and central vascularity is absent, while peripheral vascularity might be present[22].

Figure 10 depicts a histopathological proven case of PCT (Fig. 10a) with lymph nodal metastasis (Fig. 10b), as confirmed by FNAC. The lesion appears as an irregularly marginated, solid, hypoechoic nodule that is taller than it is wide, with a few micro calcific foci in the left lobe of the thyroid. This lesion falls into the TI-RADS category 5 classification. Upon further examination, an enlarged lymph node with areas of necrosis (indicated by the yellow arrow) is visible in the left station V, suggesting lymph nodal metastasis.

Anaplastic thyroid carcinoma

This condition primarily affects the elderly population and is known for its aggressive nature and poor prognosis. Patients often present with a rapidly enlarging mass within the thyroid gland, demonstrating invasion into surrounding tissues and vessels[23]. In US , the lesion appears hypoechoic with irregular margins, indicating infiltration into neighboring muscles and vessels[23,24]. Due to its large size and invasive characteristics, a comprehensive evaluation typically requires contrast-enhanced computed tomography (CT) or MRI for accurate assessment[23].

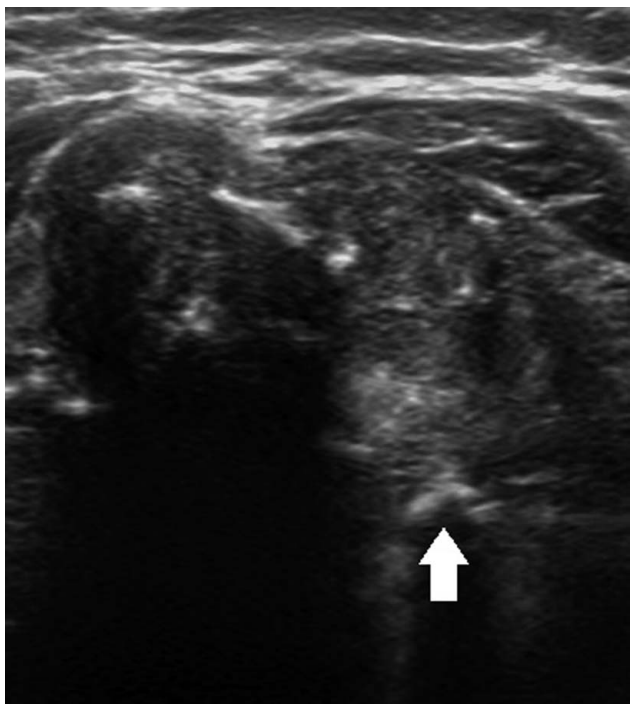

Figure 9. Ultrasonography image of medullary carcinoma thyroid. It is a solid, lobulated, hypoechoic, wider-than-taller nodule with multiple calcific foci and extra thyroid extension posteriorly. This lesion should be categorized as TI-RADS category 5.

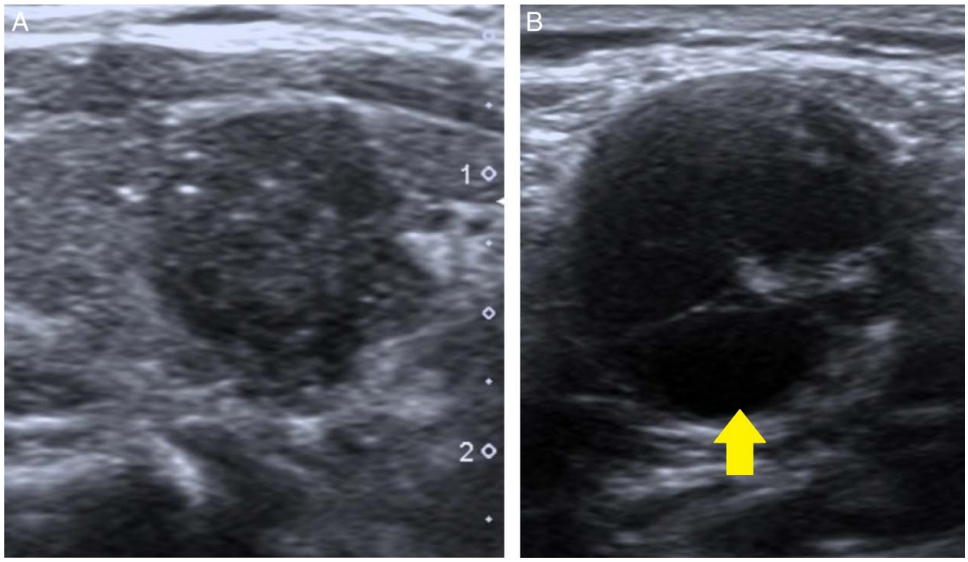

Figure 10. Ultrasonography image of papillary carcinoma thyroid with lymph nodal metastasis. (A) Shows irregular, solid, hypoechoic, taller-than-wide lesion with a few micro calcific foci in the left lobe of the thyroid. This lesion should be categorized as TI-RADS category. (B) Is an enlarged, necrotic lymph node (necrosis shown by the yellow arrow) in the left cervical station V.

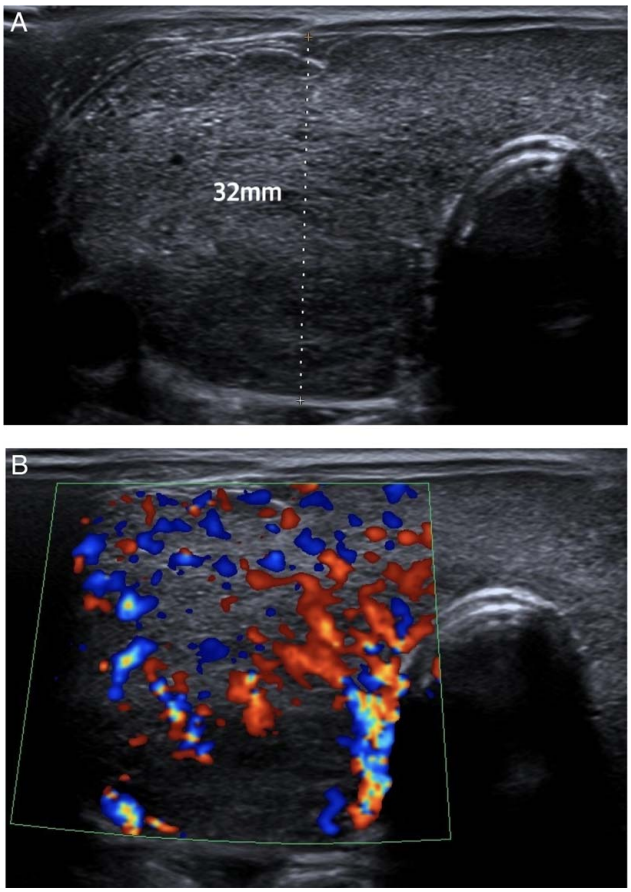

Figure 11. Ultrasonography images of Grave's thyroiditis. (A) Shows diffusely enlarged and heterogeneous thyroid gland (shown right lobe). (B) Shows diffusely increased vascularity also known as thyroid inferno pattern on color doppler.

Lymphoma

Lymphoma represents around 4% of all thyroid malignancies, with up to 80% of cases arising from pre-existing chronic lymphocytic thyroiditis[25]. Lymphoma can manifest as a nodular hypoechoic lesion or a diffuse thyroid mass. In US, the lesion appears as a very hypoechoic and lobulated structure. It may surround neck vessels, causing minimal or no attenuation of the vessel lumen. Additionally, large cystic necrosis can occur, and overall vascularity is typically reduced in these cases[25,26].

Thyroid metastases

Metastases to the thyroid gland are rare and typically originate from melanoma, breast, and renal cell carcinoma[27]. These metastases occur due to the hematogenous spread of carcinoma. In US, these lesions are usually solitary, well-defined, hypoechoic, and lack calcifications. In rare cases, diffuse involvement of the thyroid gland may also be observed[28].

Common thyroiditis encountered in clinical practice

Grave's disease

Graves' disease is an autoimmune disorder and the leading cause of hyperthyroidism. It is notably more common in females. In US, Graves' disease is characterized by the diffuse enlargement of the thyroid gland, showing a heterogeneous echotexture and increased vascularity on color Doppler, often referred to as the "thyroid inferno" pattern[29,30]. This pattern exhibits a peak systolic velocity of the inferior thyroid artery (typically measured on the left side) exceeding 40 cm/sec[29]. Figure 11 illustrates ultrasound images of Graves' thyroiditis, displaying the diffuse enlargement of the gland (Fig. 11a) and the thyroid inferno pattern on color Doppler (Fig. 11b).

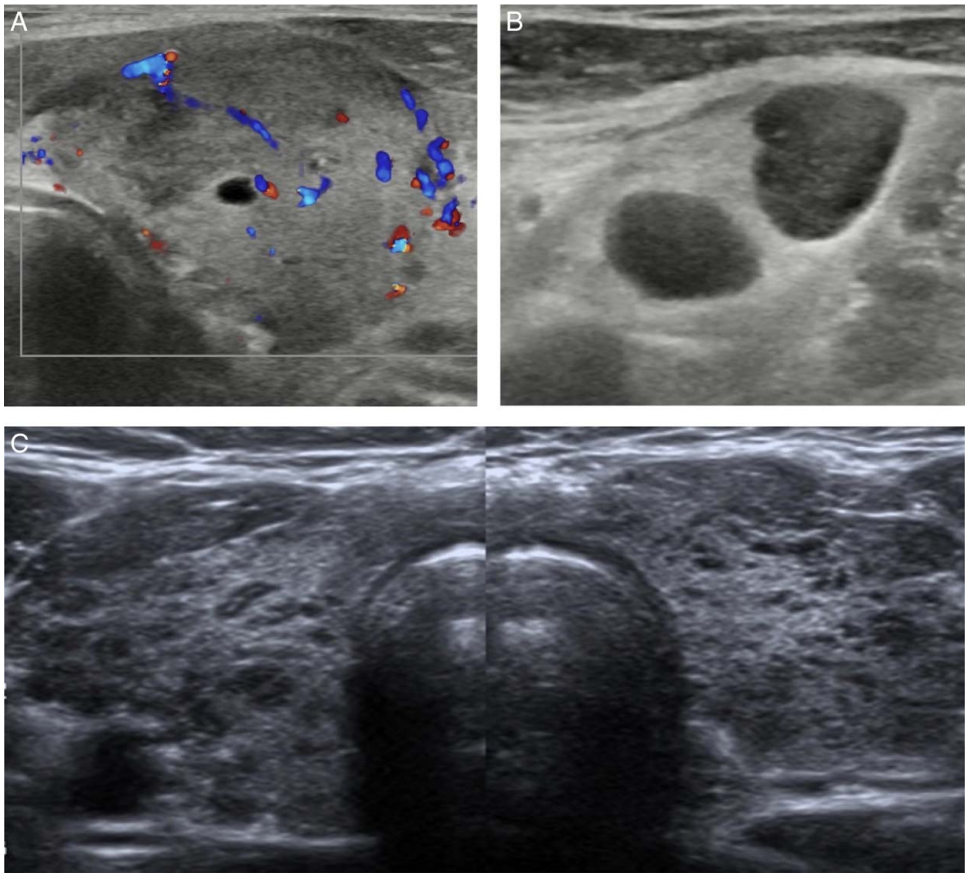

Figure 12. Ultrasonography images of subacute and chronic thyroiditis. (A and B) Show enlarged thyroid gland with ill-defined hypoechoic patches within. The vascularity is reduced in hypoechoic areas. (B) Shows enlarged perithyroid lymph nodes with maintained fatty hila. (C) Shows a diffusely heterogeneous thyroid gland with irregular outline and multiple hypoechoic nodules within.

Acute suppurative thyroiditis

This condition represents an acute inflammatory response triggered by bacterial infection. In US, an abscess or an evolving abscess can appear as a hypoechoic collection or an ill-defined hypoechoic area[31]. Additionally, there might be surrounding reactive lymphadenopathy observed in the imaging. Patients might experience symptoms such as fever, pain, and an elevated neutrophil count in the blood[32].

Subacute thyroiditis

De Quervain's thyroiditis, post-partum thyroiditis, and silent (painless) thyroiditis are forms of subacute thyroiditis[33]. Clinically, patients with these conditions typically present with painful neck swelling and/or fever. The size of the thyroid gland can be either normal or enlarged. In US, these conditions are characterized by focal ill-defined to well-defined hypoechoic areas[34]. On color Doppler imaging, reduced vascularity is observed within these areas. Figure 12A and B illustrate the US findings in a patient with subacute thyroiditis, where ill-defined hypodense patches are visible in the left lobe of the thyroid (Fig. 12A). On color Doppler, reduced vascularity within the area is evident (Fig. 12A). Additionally, a few marginally enlarged perithyroidal lymph nodes are also visible (Fig. 12B).

Chronic thyroiditis

Hashimoto's thyroiditis is a form of chronic thyroiditis associated with an autoimmune response[30]. In US, the thyroid gland can either appear normal or shrunken in size. The characteristic features include a heterogeneous echotexture with multiple small, well-defined hypoechoic nodules. Coarse hyperechoic septations are often observed within the gland, giving it an irregular outline[35]. Figure 12C illustrates a US image of chronic thyroiditis.

In the early stages, there might be a diffuse enlargement of the gland with a pattern resembling Graves' disease, referred to as the "thyroid inferno" pattern. However, in Hashimoto's thyroiditis, the peak systolic velocity of the left inferior thyroid artery is typically less than 40 cm/sec, distinguishing it from Graves' disease, where this value exceeds 40 cm/sec[29].

Conclusion

The 2017 American College of Radiology Thyroid Imaging and Reporting Data System (ACR TI-RADS) standardizes reporting, allowing accurate risk assessment, reducing unnecessary procedures, guiding clinical decisions, improving patient care, and enhancing communication among healthcare professionals. Most thyroid nodules are benign and require no active intervention.

Accurate risk stratification is hence very important. Early detection of malignant nodules helps in early intervention and reduces associated morbidity and mortality.

Ethical approval

Ethical approval need not be obtained since the article is a review.

Consent

The consent is not required since the study is a review.

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Author contribution

P.D.: data collection, manuscript writing. S.P.: statistical analysis, data collection. P.P.: data curation.

Conflicts of interest disclosure

There is no any financial and personal relationship of the authors with people or organizations that could inappropriately influence our work.

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Registration is not made since the article is a review.

Guarantor

The principal author Prajwal Dahal accepts full responsibility for the work and conduct of the study. I have access to the data and control the decision to publish.

Data availability statement

The datasets generated during and/or analyzed during the current study is not publicly available.

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Paper was not invited.

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