

# THYROID NODULES WITH AN INDICATION FOR FINE NEEDLE ASPIRATION CYTOLOGY, WHICH SHOWED BENIGNITY - PICTORIAL ESSAY

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## ABSTRACT

*Introduction: The thyroid is an endocrine gland that regulates thyroid hormones. Thyroid nodules are common, detected by ultrasound (US). Malignancy is rare, and the diagnosis depends on fine needle aspiration cytology (FNAC). ACR TI-RADS stratifies the risk of malignancy based on ultrasound findings.*

*Objective: Presenting images of thyroid nodules classified as TI-RADS 3, 4, and 5, highlighting their confirmed benignity through FNAC.*

*Methods: Images of TI-RADS 3, 4, and 5 nodules were collected from a diagnostic center, with FNAC indicating benignity.*

*Results and Discussion: The images show TI-RADS 4 and 5 nodules with highly suspicious findings, but with benign cytology. This emphasizes the need for a comprehensive evaluation, considering the nodule's size. Echogenic foci increase suspicion but are not definitive. Similarly, isolated shape doesn't guarantee malignancy. The decision for FNAC should take into account various characteristics.*

*Conclusion: The study highlights the importance of an individualized evaluation of nodules, even in TI-RADS 4 and 5 with suspicious findings. There is no definitive characteristic of malignancy, and size influences the decision for FNAC. ACR TI-RADS is useful but should be used in conjunction with clinical assessment to avoid unnecessary procedures. With advanced ultrasound techniques, the management of thyroid nodules has improved.*

**KEYWORDS:** ACR TI-RADS; THYROID; ULTRASONOGRAPHY; THYROID ULTRASONOGRAPHY; ONCOCYTIC CYTOLOGY.

## INTRODUCTION

The thyroid is an endocrine gland responsible for iodine uptake, and its microscopic architecture provides it with the ability to secrete and store thyroid hormones. Among the diseases that affect the thyroid, thyroid nodules are common and highly prevalent<sup>1-3</sup>.

They are found in approximately 8% of the adult population through palpation, 40% through ultrasound (US), and in 50% of the population through pathological examination and autopsy. Their detection has increased 2 to 4 times in the last three decades, primarily due to the advent of imaging techniques, particularly the increased use and advancement of ultrasound<sup>3-7</sup>.

The malignancy of these nodules is relatively rare, being diagnosed in less than 10% of the nodules found. The diagnosis of malignancy depends primarily on fine needle aspiration cytology (FNAC). The appropriate indication for which nodules should undergo FNAC and which should be clinically followed can be determined using a system of stratification and progressive categorization that predicts malignancy based on ultrasound findings, the Thyroid Imaging, Reporting and Data System published by the American College of Radiology (ACR TI-RADS)<sup>3, 8-15</sup>.

The characterization of a thyroid nodule based on the

system defined by ACR TI-RADS ranges from 1 to 5 and is primarily centered around evaluating five morphological characteristics: composition, echogenicity, shape, margin, and echogenic foci. Each of these characteristics receives a score, which is then summed up to determine the classification that is related to the suspicion of nodule malignancy. The recommendation is directly linked to a sixth characteristic, which is the size of the nodule. The highest potential risk of malignancy falls under the category TI-RADS 5. In other words, the system follows a pattern of increasing severity, with nodules considered non-suspicious up to the classification of TI-RADS 2. TI-RADS 4 nodules are characterized by a wide range of morphological possibilities and are considered moderately suspicious<sup>8,9-12,14,16-17</sup>.

Among the parameters evaluated on ultrasound, the following stand out: solid nodular composition greater than 50%; irregular shape; nodule visualization taller than wide; echogenic foci; solid eccentric portion; changes in echogenicity, such as marked hypoechogenicity; and solid nodules.

The shape of the nodule and the presence of echogenic foci, when considered individually, both receive a score of 3, classifying the nodule as TI-RADS 3, probably benign or mildly suspicious, with a minimum estimated risk of malignancy of 14.1%. The degree of suspicion for malignancy pro-



gressively increases based on morphological findings, reaching 45% for TI-RADS 4 and 89.6% for TI-RADS 5, which is highly suspicious. Depending on the size, fine needle aspiration cytology (FNAC) or clinical follow-up is recommended<sup>15-19</sup>. The indication for FNAC for ACR TI-RADS 3, 4, and 5 occurs when they have a larger diameter of 2.5, 1.5, and 1 cm, respectively.

The TI-RADS aims to classify the risk of a nodule being malignant in order to assist the physician in making the most appropriate decision, which may include observation of the nodule, follow-up ultrasound monitoring, or recommending fine needle aspiration cytology (FNAC) for cytological analysis of the nodule. This system seeks to streamline the interpretation of images obtained by radiologists by establishing a practical and common risk stratification, thereby maintaining a consistent language that can reduce interobserver and interdevice variations as well as the confusion in report interpretation and findings<sup>3,14-16</sup>. This approach helps avoid unnecessary invasive procedures, such as FNAC, in a significant number of patients<sup>11,15-19</sup>.

Thyroid ultrasound is the initial evaluation of the gland. FNAC, on the other hand, is a useful method, cost-effective, and less invasive for thyroid cancer detection. Most thyroid nodules are benign, and when they are malignant, they are mostly well-differentiated carcinomas.

**OBJECTIVE**

The objective is to display ultrasound images of thyroid nodules classified by ACR TI-RADS as mildly suspicious, moderately suspicious, and highly suspicious, corresponding to TI-RADS 3, 4, and 5, based on shape and/or the presence of echogenic foci, with cytology confirmed as benign through US-guided FNAC.

**METHODS**

This is a pictorial essay, meaning it consists of a collection of original images from the database of an imaging diagnostic center in São Paulo.

The eligibility criteria included nodules classified according to ACR TI-RADS as 3, 4, or 5, based on shape and/or the presence of punctate echogenic foci, with an indication for fine needle aspiration cytology. When these nodules were punctured for cytological evaluation, the results showed cellular benignity.

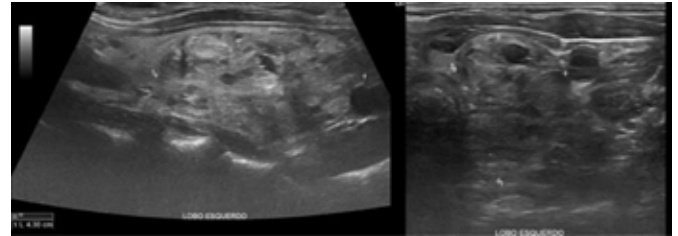
**RESULTS AND DISCUSSION**

The morphological characteristics that contributed to the scoring leading to the TI-RADS classification for each nodule will be highlighted.

In the shape category of ACR TI-RADS, the evaluation includes the relationship between the anteroposterior diameter (vertical in relation to the skin) and the horizontal diameter, measured in the transverse plane of the lobe. Nodules that are taller than they are wide, with a ratio greater than 1 for anteroposterior to horizontal diameter when measured in the transverse plane, have a higher suspicion of malignancy.

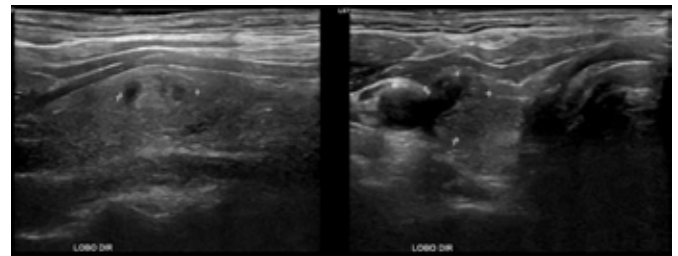
On the other hand, benign nodules often have their major axis parallel to the skin, making them wider than they are tall.

Figure 1 corresponds to a 61-year-old woman with a nodule classified as ACR TI-RADS 4. The nodule is isoechoic, predominantly solid, well-circumscribed, and taller than it is wide, measuring 4.3 cm. Cytology revealed a benign follicular nodule associated with chronic lymphocytic thyroiditis, classified as Bethesda category II.



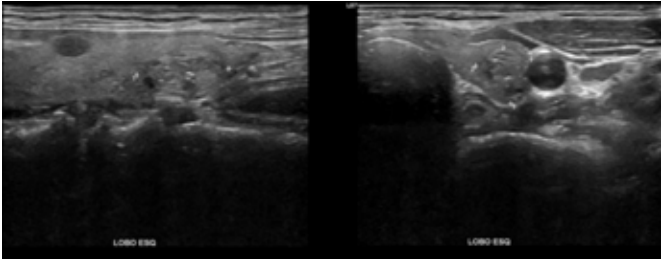
**Figure 1 – Isoechoic nodule, predominantly solid, well-circumscribed, taller than it is wide. ACR TI-RADS 4.**

Figure 2 refers to a nodule from a 40-year-old man. The nodule is isoechoic, predominantly solid, circumscribed, taller than wide, just like figure 1, it is a TI-RADS 4. The indication for FNAC did not follow the ACR TI-RADS recommendation, as the nodule does not present more than 1.5cm, and a nodule suggestive of atypia of undetermined significance was revealed, classified as Bethesda III.



**Figure 2 – Isoechoic nodule, predominantly solid, well-circumscribed, taller than it is wide. ACR TI-RADS 4.**

Figure 3 is from a 50-year-old male patient, classified as ACR TI-RADS 5 and Bethesda category II, with findings suggestive of colloid goiter. The nodule is isoechoic, predominantly solid, well-circumscribed, taller than it is wide, and has punctate echogenic foci smaller than 1 mm.

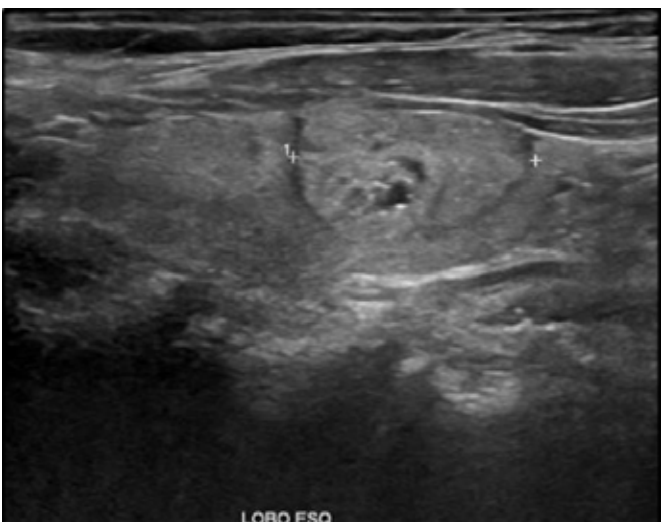


**Figure 3 – Isoechoic nodule, predominantly solid, well-circumscribed, taller than it is wide, and with echogenic foci. ACR TI-RADS 5.**

Echogenic foci are pinpoint findings of significantly increased echogenicity within the nodule and have been associated with both benign and malignant lesions. Although several studies demonstrate high specificity for the presence of echogenic foci in malignant nodules, this finding is not pathognomonic of malignancy. These are hyperechogenicities compared to the surrounding tissue and can vary in shape and size, as well as occur individually or in association with posterior acoustic shadowing artifacts.

Punctate echogenic foci or microcalcifications do not typically exhibit posterior acoustic shadowing. Macrocalcifications are large calcifications capable of generating posterior acoustic shadowing and may have irregular shapes. Peripheral calcifications are calcifications that occupy the periphery of the nodule, not necessarily continuous, and they usually produce acoustic shadows that obscure the central content of the nodule.

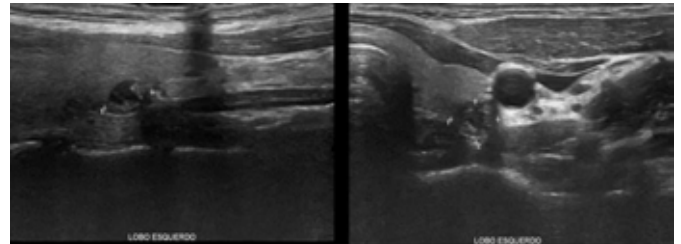
Figure 4 shows an isoechoic nodule, predominantly solid, wider than it is tall, and with echogenic foci, classified as ACR TI-RADS 4. When fine needle aspiration was performed, the cytological findings were suggestive of a follicular nodule, categorizing it as Bethesda category II.



**Figure 4 – Isoechoic nodule, predominantly solid, well-circumscribed, wider than it is tall, with echogenic foci. ACR TI-RADS 4.**

Figure 5 shows a well-circumscribed, isoechoic/mixed nodule, wider than it is tall, with the presence of echogenic foci, classifying it as TI-RADS 4. This nodule is observed in a 23-year-old female patient.

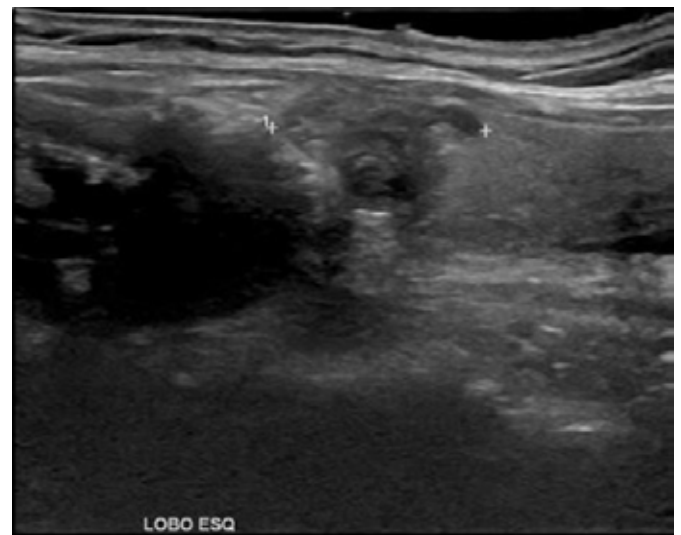
When FNAC was performed, the findings were suggestive of atypia of undetermined significance, categorizing it as Bethesda III. This diagnosis occurs in approximately 30% of patients.



**Figure 5 – Isoechoic/mixed nodule, well-circumscribed, wider than it is tall, with echogenic foci. ACR TI-RADS 4.**

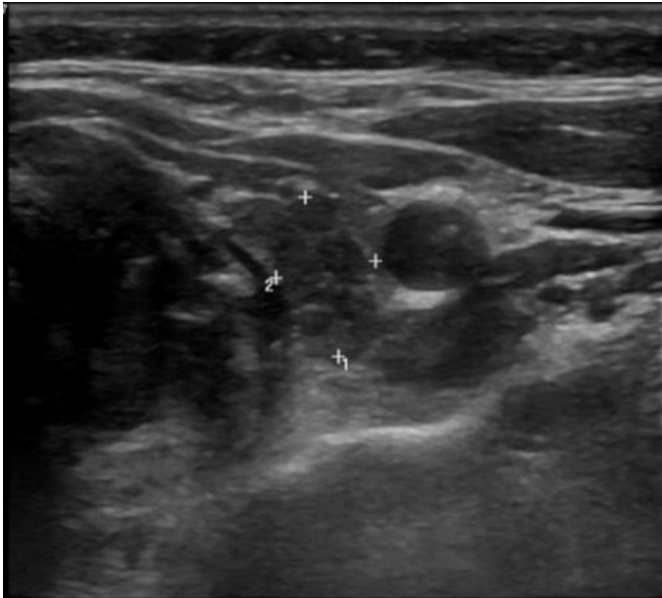
The nodules presented in this study classified as ACR TI-RADS 4 exhibit significant variability, with a predominant feature being isoechoic or predominantly solid composition, as evidenced in Figures 1, 2, 4, and 5. In Figure 3, the nodule had echogenic foci, was taller than it was wide, resulting in a 6-point increase in TI-RADS, classifying it as TI-RADS 5. This is different from Figure 4, where the nodule is wider than it is tall, and thus remains classified as TI-RADS 4.

Figure 6 displays a hypoechoic nodule (+2 points) in ACR TI-RADS. In addition to being solid, wider than it is tall (+3 points), and having echogenic foci (+3 points), the nodule is also irregular (+2 points), classifying it as TI-RADS 5. This nodule is from a 72-year-old female patient, and the cytological findings were suggestive of a benign follicular nodule, categorized as Bethesda category II.



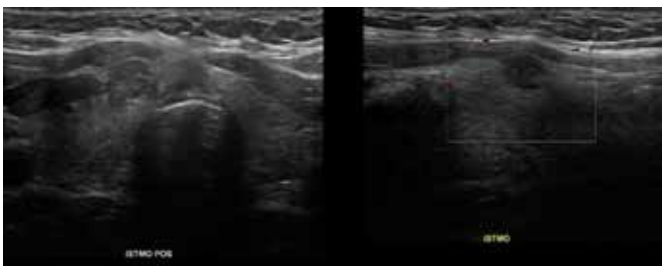
**Figure 6 – Hypoechoic nodule, solid, well-circumscribed, wider than it is tall, irregular, with echogenic foci. ACR TI-RADS 5.**

Figure 7 also shows a hypoechoic nodule, predominantly solid, taller than it is wide, without echogenic foci. Therefore, it scores 6, classifying it as TI-RADS 4. Since it was larger than 1.5 cm, FNAC was indicated, and the findings were suggestive of chronic lymphocytic thyroiditis, categorized as Bethesda category II.



**Figure 7 – Hypoechoic nodule, predominantly solid, well-circumscribed, taller than it is wide. ACR TI-RADS 4.**

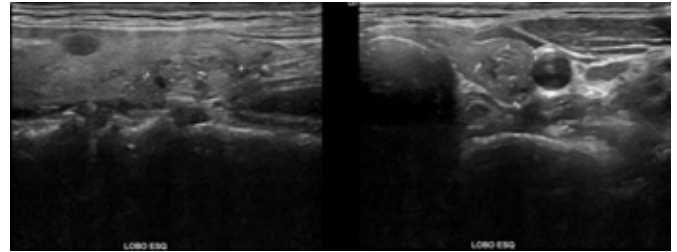
In Figure 8, the nodule is hypoechoic, solid, irregular, wider than it is tall, with the presence of discrete echogenic foci, classifying it as ACR TI-RADS 5. However, when FNAC was performed, the cytological findings were suggestive of atypia of follicular cells with rare papillary arrangements and nuclear grooves, categorizing it as Bethesda category III.



**Figure 8 – Hypoechoic nodule, solid, irregular, wider than it is tall, with echogenic foci. ACR TI-RADS 5.**

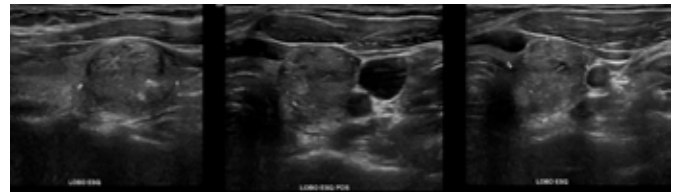
The nodule in Figure 9 is isoechoic to the thyroid gland parenchyma and predominantly solid, which earns it 2 points in ACR TI-RADS. The nodule is taller than it is wide and has echogenic foci, classifying it as TI-RADS 5. Despite the high suspicion of malignancy, when FNAC was performed, the findings were suggestive of colloid goiter,

categorized as Bethesda category II. This is a benign nodule with low malignancy risk, and therefore, the standard management is clinical and ultrasound follow-up at the determined intervals.



**Figure 9 – Isoechoic nodule, solid, taller than it is wide, with echogenic foci. ACR TI-RADS 5.**

Figure 10 is from a 33-year-old female patient with a hypoechoic nodule, meaning it appears less echogenic than the surrounding thyroid parenchyma. It is nearly completely solid, well-circumscribed, taller than it is wide, and has echogenic foci. It is classified as ACR TI-RADS 5, and the cytological findings were suggestive of a benign follicular nodule associated with oncocytic metaplasia, categorized as Bethesda category II.



**Figure 10 – Hypoechoic nodule, solid, taller than it is wide, with echogenic foci. ACR TI-RADS 5.**

Evaluating the figures in which echogenic foci are present, it is possible to demonstrate that these findings elevate the ACR TI-RADS, often associated with categorization 4 or 5, and do not necessarily correspond to microcalcifications.

In Figure 11, there is a hypoechoic nodule that is predominantly solid, well-circumscribed, taller than it is wide, with discrete macrocalcifications present. Therefore, it is classified as TI-RADS 5, and the cytology result is Bethesda category II.

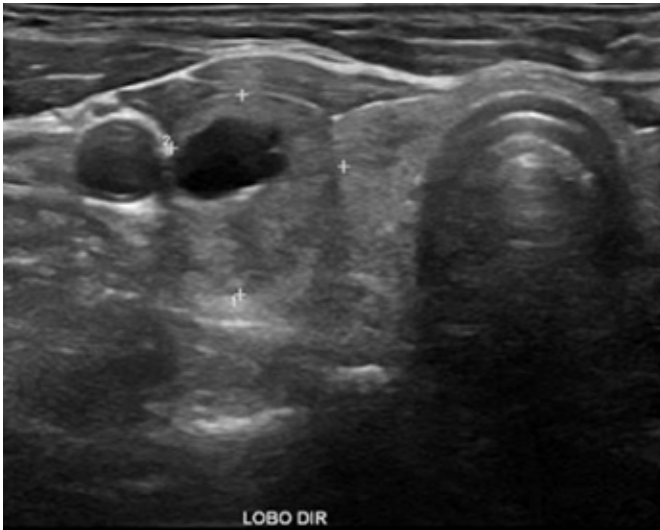


Figure 11 – Hypoechoic nodule, predominantly solid, well-circumscribed, taller than it is wide, with macrocalcifications. ACR TI-RADS 5.

In Figure 12, we observe a TI-RADS 5 nodule that is hypoechoic, solid, irregular, and taller than it is wide in a 40-year-old female patient. The Bethesda classification for this nodule was category III, which represents an indeterminate cytology result.

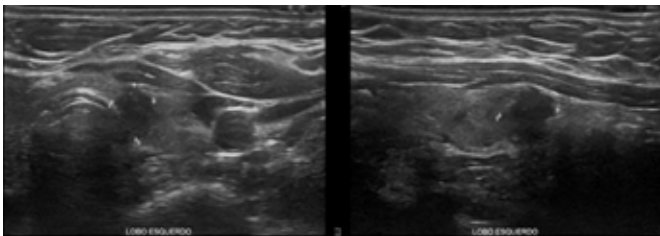


Figura 12– Nódulo hipocogênico, sólido, irregular e mais alto que largo. ACR TIRADS 5.

## CONCLUSION

With the advent of and improvements in ultrasound techniques, thyroid nodules are more easily evaluated and diagnosed. There is no single morphological characteristic that is pathognomonic of malignancy. Therefore, it is the responsibility of the imaging specialist to recognize the morphological diversity of nodules, regardless of their ACR TI-RADS classification. Specifically, when it comes to grades 3, 4, and 5, the range of variations should be observed.

Regarding the findings of echogenic foci and shape, although they score more points than other criteria, when present, they do not guarantee malignancy but rather increase suspicion. Based on this, taking into account the nodule's size, it may be indicative of PAAF. As demonstrated in the presented cases, when aspiration is performed, it can reveal benignity.

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