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Thyroid Imaging Reporting and Data System (TIRADS) Versus Thyroid Scan for Solitary Thyroid Nodules

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Abstract

Background: Solitary Thyroid nodules are a common finding which is defined as localized thyroid enlargement within an otherwise apparently normal gland. It is more common in females. Most of them are asymptomatic usually accidently discovered in neck US or carotid Doppler. Solitary thyroid nodule has a higher risk for malignancy than multiple nodules as reported in literature. Previously Radioactive Isotope scanning was first line for characterization before FNAC which is the gold standard to exclude malignancy. The availability and safety of US in addition to marvelous technological advances that yields high diagnostic power made it a prefect tool for the initial characterization of thyroid nodules. Recently TI-RADS (Thyroid Imaging Reporting and Data System) were proposed on the basis of ultrasound features for initial Solitary thyroid nodule characterization.

Aim of Study: To compare between Thyroid Imaging Reporting and Data System and thyroid scan to evaluate the malignant potentiality of the solitary thyroid nodule with taking reference the results of fine needle aspiration cytology (FNAC) and histopathology as gold standard.

Material and Methods: Thirty patients were enrolled in our cross section study with solitary thyroid nodule referred from the Otolaryngology Department to Radiology Department at Ain Shams University Hospitals. All patients underwent full thyroid ultasound examination with full comment on the nodules as regarde shape, echogenicity, margins, internal components and echogenic foci and classified according to the Americal college of radiology (ACR) Thyroid Imaging Reporting and Data System (TIRADS) Classification guideline, then thyroid scan was done to all cases. Results of both ultrasound and thyroid scan are compared with histopathological results of Fine needle aspiration cytology (FNAC).

Results: The sensitivity and specificity of TIRADS on considering TR4 and TR5 lesions positive (suspiciuos) when compared with histopathological findings were 100% and 79.2% respectively with PPV of 54.5%, NPV of 100% and accuracy of 83.3%. While isotope sensitivity when considering a cold nodule to be positive (suspiciuos) was 66.7% with specificity of 16.7%, PPV of 20%, NPV of 66.7% and accuracy of 26.7%.

Conclusion: Our results suggest that ACR TIRADS classification is superior to thyroid scan as regarde charchterization of solitary thyroid noude and considered reliable in predicting thyroid malignancy.

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Key Words: *Ultrasonography – Solitary thyroid nodule – ACR – TIRADS – FNAC – Thyroid scintigraphy.*

Introduction

THYROID nodules are a very common finding, and there is increase in its detection with the marvelous technological advances in ultrasound which is widely available [1]. Thyroid nodules are common with prevalence rate (20% to 76%), and it is more common in females and incidence increase by age [2]. Most of the thyroid nodules are asymptomatic usually accidently found in neck US or carotid Doppler. Neck US and carotid Doppler is done using linear high frequency probe, recent advances in ultrasound technology yield probes with very high resolution detecting small lesions up to 1mm as regard cystic lesion and up to 2-3 mm as regard solid lesions. The availability and safety of US in addition to the previously mentioned fact of high diagnostic power made it a prefect tool for the initial diagnosis and characterization of thyroid nodules [3]. Solitary thyroid nodules are defined as solitary localized thyroid enlargement within an otherwise apparently normal gland. Solitary thyroid nodule gains its importance for attention from the fact reported in literature, solitary thyroid nodule has a higher risk of malignancy than multiple nodules. Since then surgeons tend to treat them with degree of the suspicion with the need of preoperative treatment plan which is usually based on FNAC histopathology. Solitary thyroid nodules are common, being present in up to 50% of the elderly population [6]. In view of the fact that only about 7%-15% of cases are found to malignant so it was mandatory to establish a variety of examinations to differentiate between benign and malignant thyroid nodules [3]. Currently, fine-needle aspiration (FNA) is considered the gold standard examination to differentiate between malignant and benign lesion for future treatment plan [5]. However, the invasive nature of the procedure together with the unnecessary patients

anxiety adding to this the financial burden of the FNAC, it is found to be unpractical to biopsy all patient with solitary thyroid nodules [4]. Previously Radioactive Isotope scanning using either Iodine 123 or technetium Tc99m pertechnetate was used to classify nodules into either nonfunctioning (cold) or functioning (warm or hot) nodules. Only 5 to 15% of the cold nodules are malignant [1,8]. As the cost of radioactive isotope scan is increasing it was mandatory to find another cheaper method with comparable diagnostic value. Several trials were done by multiple professional societies to propose examinations other than thyroid scan to guide in the management plan of thyroid nodules. Recently TI-RADS (Thyroid Imaging Reporting and Data System) were proposed to guide ultrasound practitioners in recommending FNA on the basis of ultrasound features [9]. The TI-RADS, was established based on sonographic characters of thyroid nodule, such as nature (solid or cystic), echogenicity, irregular margins, calcifications, and orientation [10].

Aim of work:

The purpose of this study is to compare the positive predicative value and the negative predictive value of both thyroid scan and TI-RADS (TR4 and TR5) as regard solitary thyroid nodule with reference to FNAC histopathology.

Patients and Methods

Patients:

During a period from March 2018 to October 2018, 30 patients were enrolled in the study referred to Radiology Department at Ain Shams Main University Hospitals. All patients with solitary thyroid nodule diagnosed by ultrasound. Regarding TI-RADs classification, we allocated TIRADs (1-3) in a group (negative with low risk) and TIRADs (4-5) as another group (positive with high risk) in the mean time all patient underwent thyroid scintigraphy and also classified into two groups. first group with function nodule (hot or worm) with low risk and cold nodule with high risk. And then all results are compared with histopathological results to study the sensitivity, specificity, PPV and NPV of both techniques.

Inclusion criteria:

- Patients with solitary thyroid nodule diagnosed by U/S.
- No age predilection.
- No sex predilection.

Exclusion criteria:

- Bleeding tendency.
- Multinodular goiter.
- Patient with past history of thyroid surgery (sub total or total with recurrent nodule).
- Patient with pathologically proven malignant nodule.

Ethical consideration:

An informed consent is obtained from the patient concerning the complication of the procedure, the complication of the radioactive material, FNAC procedure and the acceptance to be enrolled in the study.

Procedure:

Each patient is subjected to full history taking and clinical examination, Ultrasound examination of the thyroid was done, characterization of the thyroid nodule according to American College of Radiology (ACR) TIRADS classification (Table 1). All patients underwent thyroid scan. Classification of thyroid nodule into functioning (worm and hot) and non functioning (cold). Correlation of the result of both TIRADS classification and thyroid scan with further histopathological examination of nodules by FNAC.

Table (1A,B): American college of radiology thyroid imaging reporting and data system (TIRADS) classification and recommendations [9].

Table (1A): US evaluation of solitary thyroid nodule.

Feature	Description and points
Shape (choose 1)	Wider than tall 0 points Taller than wide 3 points
Margin (choose 1)	Smooth or ill-defined 0 points Lobulated or irregular 2 points Extrathyroidal extension 3 points
Composition (choose 1)	Cystic or almost completely cystic 0 points Spongiform 0 points Mixed cystic and solid 1 point Solid or almost completely solid 2 points
Echogenicity (choose 1)	Anechoic 0 points no FNA Hyperechoic or isoechoic 1 point Hypoechoic 2 points Very hypoechoic 3 points
Echogenic foci (choose all that apply)	None or large comet-tail artifacts 0 points Macrocalcifications 1 point Peripheral (rim) calcifications 2 points Punctate echogenic foci 3 points

After evaluation of solitary thyroid nodule summation of points is done to determine TI-RADS grade as follow.

Table (1B)

Points	TI-RADS grade
0 points	TR1
2 points	TR2
3 points	TR3
4-6 points	TR4
>7 points	TR5

Data management and analysis:

Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Sciences) version 23.

Results

In our study, 30 patients were enrolled 22 females (73.33%) and 8 males (26.67%). The mean age group was 42.40 years ± 10.67 years. All patients had single nodule and underwent U/S with TIRADs classification, isotope scan and FNAC. The results showed that 24 nodules (80%) were cold by isotope scan and 6 nodule (20%) were functioning (Table 1). 24 nodules (80%) were benign by FNA and 6 nodule (20%) were malignant (Table 2). According to TIRADS classification 5 nodules (16.6%) were TR1, 1 (3.3%) nodule was TR2, 13 nodules (43.3 %) where TR3, 4 nodule (13.3%) were TR4 and 7 nodule (23.3%) were TR5 (Table 3).

Classifiication of nodules by isotope scan:

Table (2): Showing isotope findings.

Cold nodule	Functioning nodule
24	6

Classification of noudles by FNA:

Table (3): Showing FNA results.

Benign nodule	Malignant nodule
24	6

Classification of nodules according to TIRADS:

Table (4): Showing TIRADS classification of the nodules.

TR1	5
TR2	1
TR3	13
TR4	4
TR5	7

Table (5): Showing the number of nodules considered to be negative (TR1, TR2 and TR3 nodules) and the number of nodules considered to be positive (TR4 and TR5 nodules).

TIRADS negative	TIRADS positive
19	11

Table (6): Showing the correlation between TIRADS and FNA results as well as istope findings and FNA results.

	Pathology		Test value*	*p*-value	Sig.
	Benign	Malignant			
	No. (%)	No. (%)			
ACR TIRADS:					
Negative	19 (79.2%)	0 (0.0%)	12.955	0.000	HS
Positive	5 (20.8%)	6 (100.0%)			
Isotope:					
Functioning	4 (16.7%)	2 (33.3%)	0.833	0.361	NS
Cold	20 (83.3%)	4 (66.7%)			

Table (7): Showing TIRADS and isotope sensitivity and specificity.

	Pathology				
	Sensitivity	Specificity	PPV	NPV	Accuracy
ACR TIRADS	100.0%	79.2%	54.5%	100.0%	83.3%
Isotope	66.7%	16.7%	20.0%	66.7%	26.7%

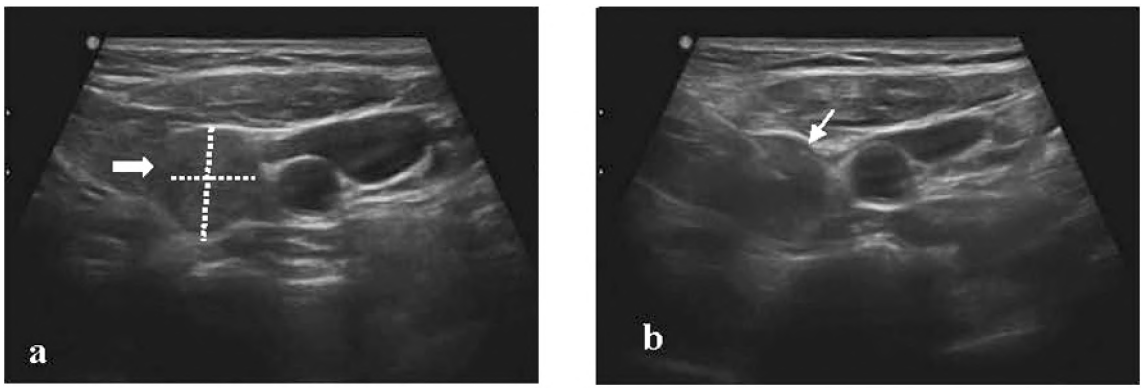

Fig. (1): US of solitary thyroid nodule. (A) Solid nodule (2 points), taller than wider dotted line (3 points), iso/hypoechoic (2 points), ill defined lobulated margin wide arrow (2 points). (B) Macrocalcification narrow arrow (1 point) TR 5 with a needle in the nodule for FNA.

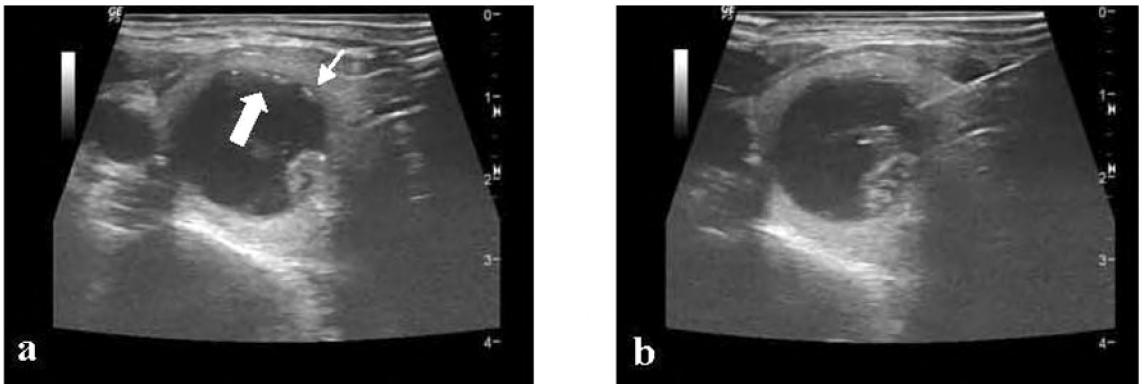

Fig. (2): US of solitary thyroid nodule. (A) Partially cystic partially solid nodule (1 points), iso/hyperechoic (1 points), lobulated margin wide arrow (2 points) pperipheral calcification narrow arrow (2 point) TR 4. (B) A needle in the nodule for FNA.

Discussion

Fine needle aspiration is a minimally invasive efficient technique for solitary thyroid nodule characterization which can efficiently differentiate between benign and malignant **[1,11,12]**. Many authors have shown that fine needle aspiration is the most sensitive cost effective and specific method to characterize solitary thyroid nodule **[13,14]**. In spite of the presence of multiple studies supporting fine needle as a cost effective diagnostic test for solitary thyroid nodule, Yet the invasive nature of FNA increase patient fear from the procedure in addition to its financial burden it was mandatory to find an initial characterization method to avoid unnecessary FNA. Many clinicians still considering thyroid scintigraphy as the primary diagnostic tool of choice for initial characterization of thyroid nodule. The continuation of this management strategy likely attributed to historical practice pattern in some institutes **[15,16]**. Comparative studies between TIRADS, scintigraphy and FNAC would be beneficial short pathway for faster shift from traditional management strategies.

In our study, we compared TIRADS result to thyroid scintigraphy as regard sensitivity, specificity, PPV and NPV with referencing to FNAC as considered the gold standard. Regarding the sensitivity and specificity of TR4 and TR5 lesions when compared with histopathological findings were 100% and 79.2% respectively with PPV of 54.5%, NPV of 100% and accuracy of 83.3%. On the other hand, isotope sensitivity when considering a cold nodule to be malignant was 66.7% with specificity of 16.7%, PPV of 20%, NPV of 66.7% and accuracy of 26.7%. Mohandas et al., results were quite similar to us when he mentioned that TIRADs sensitivity was 85.7% and specificity was 68% with accuracy of 69.2% **[17]**. Also, Basharat et al., results concerning the sensitivity and specificity of thyroid scan when compared with FNA results were 80% sensitivity and 20% specificity, PPV 10%, NPV 90% and accuracy of 26% **[18]**.

Study limitations:

A limitation of this study is that it's of relative small sample size. It would be beneficial to conduct another study on larger number of patients. Another

limitation was the absence of inter observer analysis as it was done by one radiologist. This study is a single-center study; larger multicenter is study is recommended for confirmation of our results.

Conclusion:

ACR TIRADS classification is a reliable examination for characterization of thyroid nodules which can replace the classic thyroid scan test which was readily used for thyroid nodule characterization. TIRADS has higher specificity, sensitivity positive predictor value and negative predictive value which can significantly decrease number of unneeded FNAC decreasing patient anxiety and financial burden and avoiding invasive nature of FNAC. We strongly recommend more studies as regard this issue to ensure higher level of evidence and may also introduce any suggestion for modification of TIRADS to increase specificity and sensitivity. As usage of US in TIRADS classification made it readily available, recordable, reproducible and cheaper.

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تصوير الغدة الدرقية بإستخدام التقرير ونظام البيانات TI-RADS مقابل المسح الذرى للغدة الدرقية فى حالات العقدة الانفرادية بالغدة الدرقية

الغرض من الدراسة: مقارنة بين تصوير الغدة الدرقية بإستخدام التقرير ونظام البيانات مقابل المسح الذرى للغدة الدرقية من حيث القدرة على تحديد احتمالية الأورام الخبيثة فى مرضى العقدة الانفرادية بالغدة الدرقية معا لأخذ فى الاعتبار أن تحليل الأنسجة (الباثولوجى) هو المرجع الرئيسى فى هذه المقارنة لتشخيص الأورام.

المواد والطرق: تم تسجيل لثلاثى مريضاً فى دراستنا يعانون من العقدة الانفرادية بالغدة الدرقية محولون من قسم الأنف والأذن والحنجرة إلى قسم الأشعة فى مستشفيات جامعة عين شمس الرئيسية. خضع جميع المرضى للفحص الإكلينيكى للرقبة ثم الفحص بالموجات فوق الصوتية للغدة الدرقية مع تعليق كامل على العقيدات من حيث الشكل، الصدى، الهوامش والمكونات الداخلية ثم تم تصنيفها وفقاً لمعايير الكلية الأمريكية للأشعة وبعدها خضع جميع المرضى لمسح ذرى على الغدة الدرقية. تم تجميع نتائج كل من الفحصين ومقارنتها من حيث الحساسية والخصوصية بنتائج تحليل الأنسجة بعد الوخذ الدقيق بالابرة للعقدة بالغدة الدرقية.

النتائج: TR5 و TR4 فينتائج الموجات فوق الصوتية بالمقارنة مع النتائج النسيجية كانت ١٠٠٪ و ٧٩.٢٪ على التوالى ودقة النتائج الإيجابية ٨٣.٣٪ بينما كانت حساسية المسح الذرى عند اعتبار العقدة الباردة إيجابية ٦٦.٧٪ بخصوصية ١٦.٧٪ ودقة ٢٦.٧٪.

الخلاصة: محصلة نتائج البحث أن تصوير الغدة الدرقية بأستخدام التقرير ونظام البيانات يمكن مقارنته بالمسح الذرى للغدة الدرقية ويعتبر موثقاً به فى التنبؤ بأورام الغدة الدرقية فى حالات العقدة الانفرادية.