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(RESEARCH ARTICLE)

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Correlation between ultrasound TI-RADS classification system and Bethesda cytology result in assessment of thyroid nodule among a sample of Iraqi patient in wasit province

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Abstract

Background: Thyroid nodule is a common presentation. The estimated prevalence of thyroid nodules is 5-10% by clinical examination and up to 70% on ultrasonographic (USG) evaluation. Most are benign without any symptoms or cosmetic concerns. Only around 7-15% are found to be malignant.

Objective: This study was conducted to assess the association between Thyroid Imaging, Reporting, Data System (TI-RADS) and the corresponding category of Bethesda System for Reporting Thyroid Cytology (TBSRTC) in evaluation of thyroid nodules and assessing risk of malignancy.

Methods: This retrospective study evaluated a total of 172 patients with thyroid nodules presenting to out-patient laboratory in AL-Kut in a period of three years, by categorizing them into different categories using Thyroid Imaging Reporting and Data System (TIRADS) by USG and The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) by fine needle aspiration (FNA). The correlation between TIRADS and TBSRTC was evaluated using SPSS Statistics.

Result: By FNA, 93% were benign nodules (category II-III), whereas 7.4% were malignant (category IV-V). By ultrasound 85% were benign (TI-RADS 1-3). The risk of malignancy for TI-RADS1, 2, 3, 4, 5 was 0, 0, 2.9, 38, and 80% respectively. No statistically significant difference between males and females. Overall agreement between the cases by USG and FNA using the TIRADS and TBSRTC respectively was significant ($p<0.0001$), and the area under the ROC curve was 0.913.

Conclusion: Our study observed a substantial agreement between the diagnosis made by TIRADS on ultrasound and TBSRTC on FNA, so using TI-RADS as the initial step in stratification of all thyroid nodules and as the only step in TI-RADS 1 and TIRADS2 nodules, so that only suspicious lesions undergo FNA, can reduce the need for invasive more expensive procedures without risking cancer missing.

Keywords: Fine Needle Aspiration; TBSRTC; Thyroid Nodules; TIRADS

1. Introduction

Thyroid nodules are defined by the American Thyroid Association as “discrete lesions within the thyroid gland, radiologically distinct from surrounding thyroid parenchyma” [1]. The nodules in thyroid gland are common and mostly benign, can present as both multinodular and solitary nodular goiter with higher incidence of malignancy developing in solitary nodule [2].

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The prevalence of nodular thyroid disease is highly dependent on the methods used in the studies, for example about 5-10% of population has thyroid nodule on physical examination which remains the same over decades [3]; however development and increased using of high resolution imaging technique and ultrasonography causes increase in thyroid nodule prevalence into that about 19-68%of the general population had at least one nodule.

Generally the Studies clarified that the incidence of nodular goiter is higher in women, population with iodine deficiency, in individuals exposed to radiation, and most importantly in older population [4].

Despite the fact the most of thyroid nodules are benign without any functional or cosmetic concerns, their evaluation using cost effective protocol includes combination of ultrasound and fine needle aspiration cytology is important for several reasons, one being detection their effect on thyroid gland function, and rarely, compressive symptoms, but they are primarily important because of the need to exclude thyroid cancer with average prevalence of malignancy in thyroid nodules ranges from4-6.5% [5].

1.1. Ultrasound-based TI-RADS system

Ultrasound examination of thyroid nodules provides detailed description of features of that nodule including its size, site, shape, margins, echogenicity and echotexture, as well as the presence of cystic content, and calcification; and therefore its risk of malignant changes.

For example, nodule hypo echogenicity, micro calcifications, irregular margins, and extrusion of soft tissue are suggestive indicators that the nodule malignancy is more likely.

It's important to mention that there is no single feature of the thyroid nodule on ultrasound is in isolation predictive of malignancy or benignancy, as the risk of malignancy best evaluated depending on combination of ultrasound features.

Widely used stratification system of thyroid malignancy risk is the American Thyroid Imaging Reporting and Data System (TI-RADS):

- TI-RADS I/ Benign
- TI-RADS II/ Non suspicious
- TI-RADS III/Mildly suspicious
- TI-RADS IV/Moderately suspicious TI-RADS V/ Highly suspicious
- TI-RADS VI/ Biopsy proven malignancy [6].

None of our cases turned out to be TI-RADS 6.

1.2. Cytology-based BETHSDA system

Thyroid fine needle aspiration (FNA) takes much of its clinical importance from the fact that it is reliably able to identify benign thyroid nodules, and because most thyroid nodules are benign [7,8],thyroid FNA biopsies have great value of sparing many patients from undergoing unnecessary surgery.

Ultrasound guided FNA is a safe procedure that can be performed in the office, since complications such as hematoma and sever pain are uncommon, it is also accurate as it has very low false negative and false positive rates [9].

A baseline thyroid ultrasound is essential for determining which nodules require FNA biopsy and for selecting an entry path.

Many thyroid centers are now using the Bethesda System for Reporting Thyroid Cytopathology (BSRTC), which consists of six diagnostic categories:

- Non-diagnostic/unsatisfactory
- Benign
- Atypia of undetermined significance (AUS)/follicular lesion of undetermined significance (FLUS)
- Follicular neoplasm (FN)/suspicious for follicular neoplasm (SFN)
- Suspicious for malignancy (SUSP)
- Malignant [10].

Both- the TI-RADS and BSRTC- systems are wildly used and recommended around the globe but the correlation between the two systems has not been established in the Iraqi population. Our work is an attempt to assess this correlation.

Thyroid nodules are usually detected either on physical examination or incidentally when other imaging studies are performed as they are commonly asymptomatic. The first step in evaluation of malignancy risk of nodule is using ultrasound-based stratification [11].

Many studies suggest a combination of TI-RADS system with evaluation of sonographic features of lymph nodes malignancy is safe, cost effective, and easily reproducible tool with high sensitivity that can be used to reduce the need for unnecessary thyroid FNACs especially in benign lesion [12-14], or possibility to even defer the FNACs in TI-RADS II nodules, which account for the majority of newly detected cases; because of the strong correlation between ultrasound finding and FNACs [15].

There are several studies worldwide show that ultrasound features of thyroid nodules vary in their significance related to prediction of malignancy. For example cystic content and spongiform appearance might predict benign nodules [16], while the presence of thyroid calcifications should raise the suspicion of malignancy especially in young patients with solitary nodule [17].

It's important to mention that even when these features are collectively used for diagnosis, none of them can be used alone to reliably differentiate benign and malignant nodules [18]. On the other hand some studies suggests that ultrasound features cannot be used in isolation as accurate predictors of thyroid cancer especially higher stages on TI-RADS system [16, 19].

Furthermore using ultrasound and FNACs stratification systems has been shown to improve the endocrinologists performance by allowing personalized treatment plan, reducing decision making time and errors that may result from relaying on single investigation alone [20].

2. Material and methods

2.1. Study design

Retrospective study design.

2.2. Study population

Thyroid nodule patients from both genders at any age in Wasit province. Location of study: Outpatient laboratory in Al-Kut

2.3. Time of study

Three years (2018-2020)

2.4. Sample size

172 patients with an age ranges from 17-85 divided into 123 female and 49 male patients.

2.5. Exclusion criteria

TI-RADS6 nodules, and Bethesda category 1

2.6. Ethical approval

The study was done after taking consent and getting approval from the place of study in a special manner of security and safety for participant's and no name or contact information to be provided .

2.7. Sample collection

We obtained two reports for each case; one of them was ultrasound report while the other was FNAC results which were both from Dr. Faris Lutfi's Lab. for all cases.

We then used American College of Radiology (ACR) Thyroid Imaging, Reporting, and Data System(TI-RADS) to categorize each ultrasound report based on (table 1) [21].

Table 1 American College of Radiology Thyroid Imaging, Reporting, and Data System

Point	Composition	Echogenicity	Shape	Margins	Echogenic foci
0	Cystic or spongiform	Anechoic	Wider-than-tall	Smooth or ill defined	None or large
1	Mixed	Isoechoic or hyperechoic	-	-	Macrocalcifications
2	Solid	Hypoechoic	-	Irregular	Peripheral(rim) calcification
3	-	Very hypoechoic	Taller-than-ide	Extra-thyroidal extension	Punctate echogenic foci

For the FNAC report, The Bethesda System for Reporting Thyroid Cytopathology (BSRTC) was already applied on reports.

Data were organized and analyzed by using SPSS statistics V 24.

3. Results

Total of**172** patients were included in this study, out of which 123 were females. Participants' age was predominantly found in the third to sixth decades, with patients aged between 20-60 years accounting for about 86% of our study population (figure 1).

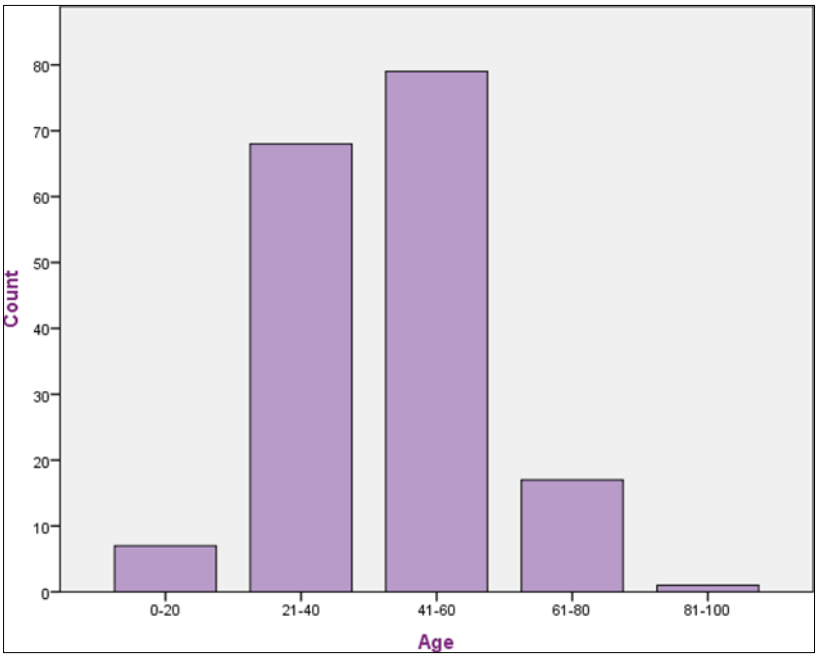

Figure 1 Age distribution of the study population

Most of the thyroid nodules came under TIRADS 2- 3 classifications on ultrasound, accounting for around 76% of the sample.

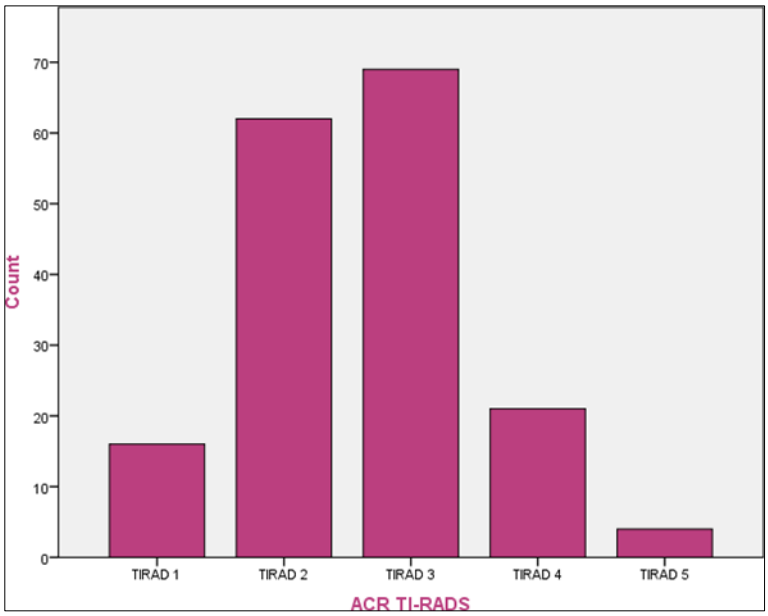

Figure 2 classification of nodules according to TI-RADS

While using FNAC, about 93% of the sample turned out to be category II and III in Bethesda classification system, figure3.

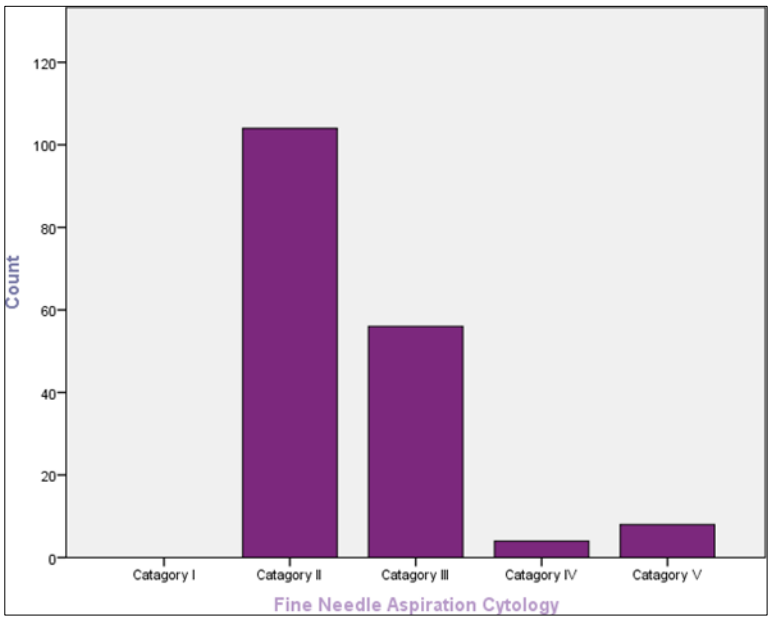

Figure 3 Classification of nodules according to Bethesda system

None of the 78 TI-RADS 1,2 nodules turned to be Bethesda IV or V.

Among 69 TI-RADS 3 nodules, only two cases were Bethesda VI or V, figure4.

All of the cases below the age of 20 years turned out to be Bethesda II or III. Our study shows significant association between TI-RADS and Bethesda systems(P value<0.0001).The area under the ROC curve= 0.913, which indicates that ultrasonography is both specific and sensitive test compared to the standard invasive cytology test.

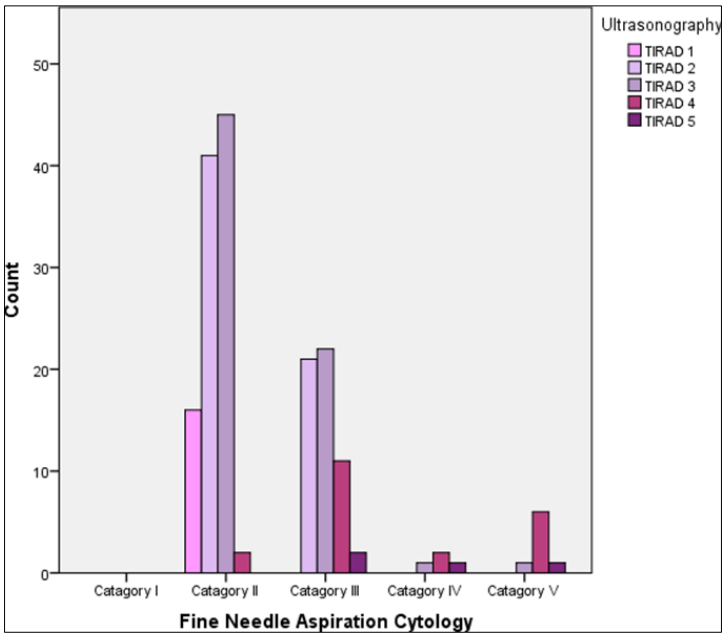

Figure 4 ACR TI-RADS and Bethesda systems correlation

4. Discussion

Thyroid nodule with or without functional problems is common clinical confrontation; therefore idealization of diagnostic approach especially for malignancy risk evaluation is a necessity. Ultrasonic examination is considered the initial step in that approach for all cases, being cost-effective and non-invasive procedure.

However, this agreement on the first step does not exist in the following steps of the evaluation protocol, since the indication for FNA recommendations for thyroid patient are still controversial. FNAC tests are very useful in detecting malignancy, with that being said it's also minimally invasive procedure with higher cost and less availability than ultrasonography, so performing such a test to about 70% of the population -which the incidence of thyroid nodule detected by ultrasound- is neither cost effective nor advisable. To solve this dilemma, several classifications systems based on ultrasound were proposed in the past in attempt to detect the ultrasonographic features (including the nodule composition, margins, shape, etc...) that best predict malignancy risk in thyroid nodules.

It's important to remember that there is no single feature can reliably isolate benign from malignant nodules [6].

In our study we assessed the correlation between ultrasound-based classification system and cytopathology-based system in order to evaluate the reliability of TI-RAD system to detect or exclude malignancy compared to the gold standard which we considered cytology, however a more accurate assessment would be achieved by comparing ultrasound finding to histopathology. 172 cases were predominantly females, which is corroborated with previous literature [4]. The results show no statistically significant association with either the sex or the age of the participants, which may be contributed to the poor representation of both ends of the age spectrum in this study.

After analyzing the results there was a significant association between diagnoses made using ultrasound-based system (TI-RADS) and those were made according to Bethesda system(P<000.1).

The statistics confirmed that TI-RADS has a very good accuracy assessed by measuring under the ROC curve which was 0.913. Our study involve 20 and 62 cases of TI-RADS1-2 none of them turned to be malignant (malignancy risk is0%), malignancy risk in TI-RADS 3 is about 2.9%. For TI-RADS4 cases 38% were malignant on FNAC. 4 out of five in TI- RADS 5 turned to be malignant (80%).

These results are similar to many studies all over the world, for instance Horvath et al. used ten sonographic features to classify thyroid nodules into TI-RAD2-6 dividing TI-RADS4 into4 A and 4B sub category. The risk of malignancy in this study was 0% for TI-RADS2, 3.4% in TI-RADS3 patients, ranges from10-80% inTI-RADS4, and as high as 87% in TI-RADS5 [22].

Another study is Kwak et al. retrospective study where 5 features were used to classify each nodule sonographically, without taking into account the significance of those features and their different accuracy in prediction of malignancy risk.

Despite that, similar results can be seen in that study as well, with malignancy risk of TI- RADS 2, 3, 4, and 5 nodules is0, 1.7, 3.3-72.4, and 87.5% respectively [23]. (Table 2) [15].

Table 2 Malignancy risk in TI-RADS categories according to different studies

TI-RADS	Our study	Horvath et al. [22]	Kwak et al. [23]
TIRADS1	0%	0%	0%
TIRADS2	0%	0%	0%
TIRADS3	2.9%	3.4%	1.7%
TIRADS4	38%	10-80%	3.3-72.4%
TIRADS5	80%	87%	87.5%

Other studies such as study by Moifo et al., which was conducted in France and Srinivas et al. study from Indian literature, suggest that malignancy in TI-RADS5 nodules is confirmed (100% malignancy risk), this result may come from using a more accurate diagnostic tool which is histopathology, or simply because of the few number of TI-RADS 5cases our research included [24, 25].

5. Conclusion

In our study, there was no risk of malignancy in nodules with TI-RADS 1 or 2. So, if a nodule is properly classified into these two categories based on ultrasonic features, it can be safely said that there is no need of FNA in TI-RADS 1, as well as it can be deferred inTIRADS2 at least. Our study also shows very high risk of malignancy in TI-RADS 5 nodules, there for appropriate measures of management can be initiated before obtaining FNA results, especially in those with severe symptom.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

There is no conflict of interest in our faculty.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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