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Concordance between BETHESDA Cytology Classification and ACR-TIRADS Ultrasound Classification in the Evaluation of Thyroid Nodules at Tikur Anbesa Specialised Hospital, Addis Ababa, Ethiopia: A Prospective Study from April 2023 to October 2023

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ABSTRACT

Background and objective: The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) is a widely used system of reporting currently helping in the management of thyroid nodules, which are common and mostly benign. The American College of Radiology Thyroid Imaging Reporting and Data System (ACR-TIRADS) is also a widely used classification system that has helped in screening for nodules requiring subsequent fine needle aspiration cytology, but the correlation between the two systems has not been established in our setup. This study aims to determine the level of concordance between the cytology category based on TBSRTC 2017 and the ultrasound TIRADS category based on ACR-TIRADS 2017.

Methodology: It was a prospective cross-sectional study over 6 months that included 92 patients with thyroid nodules. In all cases, the thyroid ultrasound and cytology findings were reported based on ACR-TIRADS 2017 and TBSRTC 2017, respectively. The level of agreement between ACR-TIRADS and TBSRTC systems was expressed as a kappa value.

Results: Study subjects were mostly women (84%), with an average age of 47.60 years. The highest frequency in the Bethesda system was seen in category II (54/92) and category V (17/92). In contrast, the highest frequency in TIRADS was in category 4 (45/92) and category 3 (21/92). Maximum concordance was found among the categories 2-II and 5-V of the classification systems. The overall observed agreement was 65.2% with a linear weighted kappa of 0.343 (95% CI: 0.213-0.472). A higher weighted kappa value was seen in males, nodules ≥4 cm, individuals aged <50 years and in those whose fine needle aspiration was done with freehand.

Conclusion: The study revealed a fair concordance between cytologic diagnosis based on the TBSRTC and ultrasound diagnosis based on the ACR-TIRADS, with the highest concordance seen in the two ends of the classification categories (TIRADS 5-Bethesda V and TIRADS 2-Bethesda II). Careful interpretation of the ultrasound findings and cytologic specimens allows the treating physicians to decide which nodules need surgery and follow-up so that there will be no unnecessary surgical procedures and complications. There should be an institutional monitoring system for nodules with discordant Bethesda and TIRADS categories, especially for those with extreme categories that are produced.

Keywords: Thyroid Nodule, Bethesda, Ultrasound, TIRADS, FNAC, Concordance

Abbreviations: ACR: American College of Radiology; FNAC: Fine Needle Aspiration Cytology; MRN: Medical Record Number; NPV: Negative Predictive Value; PPV: Positive Predictive Value; TASH: Tikur Anbessa Specialized Hospital; TBSRTC: The Bethesda System for Reporting Thyroid Cytopathology; TIRADS: Thyroid Imaging, Reporting and Data System; US: Ultrasound

1. Introduction

In recent decades, a steady increase in the incidence of thyroid cancer has been observed worldwide and the reasons for this increase remain controversial. The increase in thyroid cancer is almost exclusively due to the increase in papillary cancers and there are no significant changes in other histological subtypes[1-3]. The typical presentation is small tumors although the incidence of large tumors is increasing; it has been suggested that the increase in the incidence of thyroid cancer is largely due to better detection rather than an actual increase in incidence[3]. Thyroid cancer is the most common endocrine malignancy.

A thyroid nodule can be defined as a discrete lesion within the thyroid gland that is radiologically distinct from the surrounding thyroid parenchyma. It may be solitary, multiple, solid or cystic and may or may not be functional. Thyroid nodules are common in the general population and ultrasonography (US) has greatly increased the number of cases detected. About 4% to 8% of the thyroid nodules are detected by manual palpation. Ultrasound is an accurate method for the detection of thyroid nodules, but its accuracy in differentiating between benign and malignant thyroid nodules is low[4,5]. Hypoechogenicity, increased intranodular vascularity, irregular margins, microcalcifications, an absent halo and a taller-than-wide shape measured in the transverse dimension are the commonest sonographic features associated with a higher likelihood of malignancy. Thus, several US Thyroid Imaging and Data Systems (TIRADS) have been proposed for risk stratification of thyroid nodule[5]. The nodules are usually divided into different categories based on TIRADS and are then referred for fine needle aspiration cytology (FNAC) or follow-up, according to the variable risk of malignancy. ACR-TIRADS was originally designed to improve patient management and cost-effectiveness by avoiding unnecessary FNAC in patients with thyroid nodules (Table 1), with a sensitivity, specificity, positive predictive value, negative predictive value and accuracy of 88, 49, 49, 88 and 94%, respectively[6].

In addition, FNAC is the most accurate method for determining malignancies and is an integral part of the current evaluation of thyroid nodules.

The Bethesda System for Thyroid Cytopathology Reporting is a standardized reporting system for classifying thyroid FNAC results and includes six diagnostic categories with unique risk of malignancy and clinical treatment recommendations. The Bethesda system has been widely adopted since its commencement, each category with malignancy risk and recommended next steps (Table 2). A recent meta-analysis showed that the Bethesda reporting system has a sensitivity of 97%, specificity of 50.7%, negative predictive value of 96.3% and positive predictive values of 55.9%[7,8].

Despite the fact that both US and FNAC are widely recommended procedures to study patients with thyroid nodules, the value of the existing concordance between the two methods has not been established in our setup. Consequently, the purpose of this study was to assess the existing level of concordance between the two diagnostic methods used in the initial evaluation of individuals with thyroid nodules (ACR-TIRADS 2017 and TBSRTC 2017).

Table 1: ACR-TIRADS 2017[6,9,10].

TIRADS Category	Definition	Subsequent Recommendation
TIRADS 1	Benign	No FNAC
TIRADS 2	Not suspicious	No FNAC
TIRADS 3	Mildly suspicious	FNAC if size ≥2.5 cm Follow-up if size ≥1.5 cm
TIRADS 4	Moderately suspicious	FNAC if size ≥1.5 cm Follow-up if size ≥1.0cm
TIRADS 5	Highly suspicious	FNAC if size ≥1.0 cm Follow-up if size ≥0.5 cm

Table 2: The Bethesda system for reporting thyroid cytopathology 2017[7,8,11,12].

Bethesda Category	ROM Mean % (Range)	Usual Management
Bethesda I (Nondiagnostic)	13 (5-0)	Repeat FNA with ultrasound guidance
Bethesda II (Benign)	4 (2-7)	Clinical and ultrasound follow-up
Bethesda III (AUS)	22 (13-0)	Repeat FNA, molecular testing, diagnostic lobectomy or surveillance
Bethesda IV (Follicular neoplasm)	30 (23-34)	Molecular testing, diagnostic lobectomy
Bethesda V (Suspicious for malignancy)	74 (67-83)	Molecular testing, lobectomy or near-total thyroidectomy
Bethesda VI (Malignant)	97 (97-100)	Lobectomy or near-total thyroidectomy

2. Methods

2.1. Objectives

The main objective of the study was to determine the level of concordance between the ultrasound category established under ACR-TIRADS and the cytology category according to TBSRTC. Additionally, the study population and level of concordance of the classification systems are characterized from the socio-demographic point of view, the Bethesda categories are characterized in terms of frequency and pathologic diagnosis and the prevalence of benign and malignant lesions is assessed based on the cytologic diagnosis.

2.2. Study setting, Study design, Study duration

2.2.1. Study setting: The study was conducted at Tikur Anbessa Specialized Hospital (TASH), Pathology Department, Addis Ababa, Ethiopia. TASH is under College of Health Sciences of Addis Ababa University, which is one of the pioneer universities in the country. The hospital is a tertiary-level referral and teaching hospital providing service to people from all corners of the country in its various departments. The study was conducted

in the Pathology department with collaboration from Radiology department. Both departments are equipped with qualified human resources including consultant pathologists and radiologists that are involved in conducting and guiding the research.

2.2.2. Study design and duration: An institution based prospective, cross-sectional study was conducted in patients referred for freehanded FNAC at the Pathology department and ultrasound-guided FNAC at the Radiology department of TASH during the time period of April 2023 to October 2023.

2.3. Population

2.3.1. Source population: All patients referred to Tikur Anbessa Specialised Hospital Pathology Department for freehanded FNAC and Radiology Department for ultrasound-guided FNAC from thyroid nodules during the study period of April 2023 to October 2023.

2.3.2. Study population: All patients referred to the TASH Pathology Department for freehanded FNAC with ultrasound report and Radiology Department for ultrasound-guided FNAC from thyroid nodules during the study period of April 2023 to October 2023.

2.4. Sample size and sampling technique

Since the number of both freehanded and ultrasound-guided thyroid FNAC cases done at both departments of TASH was small, non-probabilistic sampling technique was used and all patients for whom ultrasound-guided or freehanded FNAC is done were included in our study. Upon consecutive non-probabilistic sampling, initially 115 patients were included; however, the final analysis was limited to 92 patients and 23 patients were excluded due to:

- Bethesda category I cytology result in 13 cases.
- Cytology report not based on TBSRTC in 1 case.
- TIRADS 1 in 1 case.
- Ultrasound report done outside of TASH in 1 case.
- Post thyroidectomy in 7 cases.

2.5. Data collection procedure

Data was collected by using structured questionnaire. The questionnaire included the Medical Registration Number (MRN), demographic data (the age and sex) of the patient, duration of the nodule, size of the nodule from measurement of ultrasound, presence or absence of toxic symptoms, the TIRADS category, the Bethesda category and the specific pathologic diagnosis rendered.

2.6. Study variables

2.6.1. Dependent variables: Bethesda (TBSRTC) category and ACR-TIRADS category.

2.6.2. Independent variables: Age, sex, duration of lesion, presence or absence of toxic symptoms, nodule size, mode of aspiration.

2.7. Eligibility criteria, inclusion criteria, exclusion criteria

2.7.1. Eligibility criteria: All thyroid nodules for which freehanded and ultrasound-guided FNAC were done at Tikur Anbessa Specialized Hospital, pathology and radiology department, were included in this study.

2.7.2. Inclusion criteria: All thyroid nodules for which freehanded or ultrasound-guided FNAC were done, provided that ultrasound report with ACR-TIRADS category and cytology results with TBSRTC category were obtained. For FNAC done in more than one thyroid nodules of the same patient; the nodules were recorded as separate data set; provided that the ultrasound report has separate ACR-TIRADS and TBSRTC.

2.7.3. Exclusion criteria:

- All thyroid nodules for which the ultrasound and cytologic result could not be produced.
- Those with repeat aspiration within same study period.
- Those with the ultrasound examination done outside TASH.
- TIRADS 1 and Bethesda category I cases.
- All nodules in a patient with known thyroid malignancy or previous thyroidectomy.

2.8. Data processing and analysis

All the nodules for which the ultrasound report consists of the ACR-TIRADS category and cytology result reported by TBSRTC system were included in the study. The weighted Kappa statistical method with a 95% confidence interval and the statistical Z-test were used to estimate the level of concordance between the two systems. A p-value of < 0.05 was considered statistically significant.

In order to undergo the Kappa analysis, the number of diagnostic categories in the ACR-TIRADS system and TBSRTC should be equal. The first category of both systems is excluded because category 1 in TIRADS is benign for which FNAC is not ordered and, in TBSRTC, is non-diagnostic. And category V and VI of TBSRTC are combined into one because the highest risk of malignancy is described in those two categories. As a result, the analysis categories are:

- Bethesda category (II, III, IV and V)
- TIRADS category (2, 3, 4 and 5)

In this study we used cohen's kappa with linear weight to determine the level of concordance. A further analysis was done to assess factors resulting in variation in weighted kappa for the variables of gender, age, nodule size, presence or absence of toxic symptoms and mode of aspiration. All the analyses were based on SPSS version 27.

3. Results

A total of 92 patients were included in this study; in 45.65% (n = 42) of cases, the FNAC was done under ultrasound guidance, whereas 54.35% (n=50) of cases were aspirated freehanded. The majority of patients (84.8%, n=78) were female, with female-to-male ratio of 5:1. Each Bethesda category shows exclusive female predominance (>80% were female), except for category V, where male-to-female ratio is 1.4:1 (41.2% and 58.8%). The average age was 47.60 years (SD = 14.63) with minimum and maximum of 14 and 90 years, respectively. Of the 92 patients, 43.5% were above the age of 50 year (Figure 1).

Mean size of nodules was 3.72 cm (SD = 1.26, minimum = 1.8 cm and maximum = 7.4 cm). In 63.04% (n=58) of nodules, the size was below 4 cm. There was no statistically significant size variation between Bethesda categories (p = 0.082).

The majority of patients (77.2%, n = 71) were seen to have toxic symptoms. The prevalence of toxic symptoms in cases

categorized as Bethesda category (IV and V) was 3.125%. Out of 32 cases reported as Bethesda category IV and V, toxicity is seen in only 1 case (Table 3).

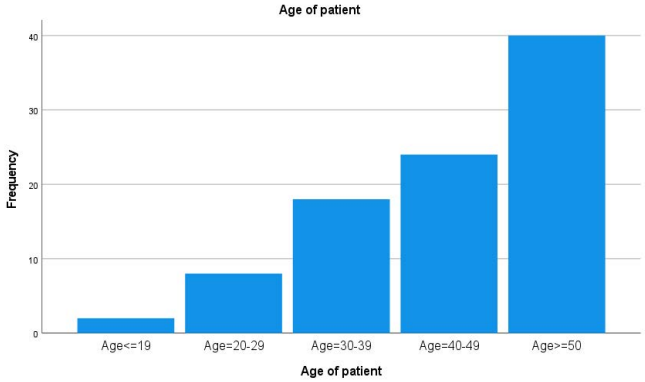

Figure 1: Study subjects according to their age distribution.

The frequency of ultrasound results in TIRADS category, was TIRAD2 (20.7%, n=19), TIRAD3 (22.8%, n=21), TIRAD4 (38.0%, n=34) and TIRAD5 (18.5%, n=17) (Figure 2).

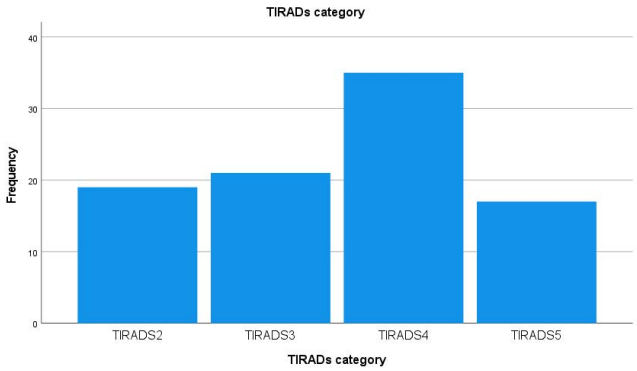

Figure 2: Frequency distribution of study subjects based on TIRADS Category.

Table 3: Age, sex, size nodule, presence or absence of toxic symptoms and duration of lesion in each Bethesda categories.

	Age	Sex	Size of nodule in cm	Toxicity prevalence	Duration in year
Bethesda II	Min=14 Mean=48.04 Maximum=90 SD=15.7	Female=96.6% Male=7.4%	Minimum=1.8 Mean=3.57 Maximum=7 SD=1.09	33.3%	Min=1 Mean=6.28 Max=30 SD=6.43
Bethesda III	Min=29 Mean=45 Maximum=68 SD=13.5	Female=100%	Minimum=2.20 Mean=3.12 Maximum=4.1 SD=0.82	33.3%	Minimum=1 Mean=5.17 Maximum=12 SD=3.92
Bethesda IV	Minimum=20 Mean=47.47 Maximum=70 SD=14.67	Female=80% Male=20%	Minimum=1.80 Mean=3.88 Maximum=6.5 SD=1.49	6.7%	Minimum=1 Mean=4.33 Maximum=20 SD=5.06
Bethesda V	Minimum=25 Mean=47.24 Maximum=69 SD=12.31	Female=58.8% Male=41.2%	Minimum=2.00 Mean=4.25 Maximum=7.4 SD=1.54	0%	Minimum=1 Mean=3.06 Maximum=10 SD=2.95

The frequency of Bethesda category II (58.7%, n=54), III (6.5%, n=6), IV (16.3%, n=15) and V (18.5%, n=17) (Figure 3).

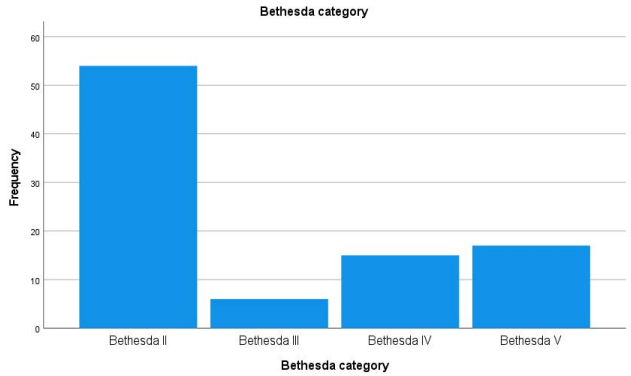

Figure 3: Frequency distribution of study subjects according to Bethesda category.

Table 4: Joint distribution of TIRADS and Bethesda categories.

		Bethesda Category				Total
		II	III	IV	V	
TIRADs category	TIRADS2	16	1	2	0	19
	TIRADS3	14	3	3	1	21
	TIRADS4	22	2	7	4	35
	TIRADS5	2	0	3	12	17
	Total	54	6	15	17	92

The non-diagnostic rate (Bethesda category I) in our study was 11.3% (13/115) and the majority of thyroid nodules that turned out to be non-diagnostic were those aspirated under ultrasound guidance (84.6%) (Table 5).

Table 5: Nondiagnostic rates based on mode of aspiration.

Mode of Aspiration	Number of Nondiagnostic Cases (%)
Ultrasound-guided	11 (84.6%)
Free handed	2 (15.4%)

Colloid goiter is the most prevalent cytologic diagnosis, accounting for 56.5% (n = 52) of total cases and 96.3% of cases reported as Bethesda category II. The majority of cases categorized as Bethesda Category VI turned out to be papillary thyroid carcinoma (67%, n = 8); the remaining cases in this category are anaplastic thyroid carcinoma (16.7%, n = 2), metastatic carcinoma suggestive of renal cell carcinoma (8.3%, n = 1) and squamous cell carcinoma (8.3%, n = 1). The prevalence of malignancy as per the cytologic diagnosis was 13% (Table 6).

The overall observed agreement between the TIRADS and Bethesda categories was 65.2%, with estimated agreement (agreement by chance) of 48%. The highest concordance was found for categories TIRADS 5-Bethesda V (70.6%). Out of 17 cases classified as TIRADS 5 category, 12 were rated as Bethesda V, 3 as Bethesda IV and 2 as Bethesda II. The frequency of Bethesda V was 18.5% (17/92); 12 of the patients were rated as TIRADS 5, 4 as TIRADS 4 and 1 rated as TIRADS 3.

Table 6: Bethesda categories with cytology diagnosis.

Bethesda category (Number of cases and percentage out of total)	Cytologic diagnosis, number of cases with percentage within category
Bethesda II, 54(58.7%)	Colloid Goiter, 52(96.3%)
	Adenomatoid Goiter, 1(1.85%)
	Reidel's Thyroiditis, 1(1.85%)
Bethesda III, 6(6.5%)	AUS
Bethesda IV, 15(16.3%)	Follicular neoplasm, 10(66.7%)
	Suspicious for follicular neoplasm, 4(26.7%)
	Hurthle cell neoplasm, 1(6.6%)
Bethesda V, 5(5.43%)	Suspicious for papillary thyroid carcinoma, 3(60%)
	Suspicious for malignancy, 2(40%)
Bethesda VI, 12 (13.04%)	Papillary thyroid carcinoma, 8(66.7%)
	Anaplastic thyroid carcinoma, 2(16.7%
	Squamous cell Carcinoma, 1(8.3%)
	Suggestive of metastatic Renal cell carcinoma 1(8.3%)

The next highest agreement was between categories of Bethesda II-TIRADS 2. Out of 19 cases categorized under TIRADS 2, 16 turned out to be Bethesda II, 1 Bethesda III and 2 Bethesda V.

The weighted kappa value calculated was 0.343 (95% CI, 0.213-0.472, P<0.01, Z=5.124). And a higher weighted kappa value was seen in male patients, nodules ≥ 4 cm, individuals < 50 years of age and patients whose FNAC was done freehanded. ACR-TIRADS categorization of thyroid nodules is found to have sensitivity (81.25%), specificity (56.67%), positive predictive value (50%) and negative predictive value (85%) (Table 7).

Table 7: The kappa value variation for age, sex, nodule size, toxicity and mode of aspiration.

Variable	Kappa	Standard error	IC 95%
Overall kapa	0.343	0.066	0.213-0.472
Sex Male	0.556	0.138	0.286-0.825
Female	0.28	0.07	0.143-0.416
Age <50	0.456	0.094	0.272-0.641
≥50	0.218	0.074	0.072-0.364
Size <4cm	0.284	0.087	0.113-0.455
≥4cm	0.419	0.104	0.216-0.623
Toxicity Yes	0.114	0.072	0.028-0.256
No	0.38	0.073	0.237-0.524
Mode of aspiration			
Ultrasound guided	0.196	0.068	0.063-0.329
Free handed	0.436	0.1	0.24-0.632

4. Discussion

This study evaluated the concordance between the ACR-TIRADS 2017 and TBSRTC 2017 on the evaluation of thyroid nodules. The result showed a fair concordance and the most frequent agreement was found for categories 5-V and 2-II. The kappa index measures the level of inter-observer agreement or, as in this study, the concordance between the category produced by ultrasound TIRADS and the cytology result produced by TBSRTC. Kappa is a measure of reliability, not a measure of validity.

The majority of patients in our study were female (84.8%). Other similar studies also reported a predominance of the female population presenting with thyroid lesions[11,13-15,16-18]. Probably this trend is due to the fact that autoimmune thyroid disease is significantly more frequent in females than in males, so these patients with autoimmune thyroid disease visit the physician more often, increasing the probability of detecting the nodules either through palpation or ultrasound; clinically this situation may be defined as a "medical surveillance bias"[11] Increased prevalence of thyroid lesions in females, according to studies, might be related to hormonal influence of estrogen and progesterone[14].

The mean age of our patients was 47.60 (SD = 14.67); this finding is similar to those reported previously by Pudasaini et al.[18] (48.9, SD 14.2) and Redmi S et al.[14] (50.74, SD = 17.8) and older and younger than those reported by Biswas A et al.[13] (41.54, SD = 11.86) and Vargas H et al.[11] (57, SD = 14), respectively.

Bethesda II was the most frequent category, 54/92 (58.7%) and colloid goiter is the most prevalent cytologic diagnosis, accounting for 96.3% of Bethesda II cases and 56.5% of all cytologic diagnoses in this study. Similar findings of the predominance of Bethesda category II were seen in other studies by Vergas H et al.[11](36.1%), Biswas A et al.[13] (56.52%), Redmi S. et al.[14] (68.5%) and Singapore W et al.[19](74.65%).

The overall agreement between TBSRTC and ACR-TIRADS found in our study was 65.2% with expected agreement of 48%. Similar observed agreement is seen in a study done by Chumber S et al.[15] (64%) with lower expected agreement of 41.6%. A higher overall agreement is seen in studies done by Redmi S, et al. (77.77%) and Singapore W et al. [19](83%).

The highest level of agreement between Bethesda and TIRADS categories is seen between categories TIRADS 5-Bethesda V and TIRADS 2-Bethesda II. A study done in India by Chumber S. et al.[15]has shown a similar higher concordance rate between categories of TIRADS 2-Bethesda II and TIRADS 5-Bethesda V. Other studies have also revealed a higher agreement level between categories of TIRADS 2-Bethesda II[11,13,20,21].

The weighted kappa value generated in our study was 0.343, which implies the two diagnostic systems have a fair concordance rate. A similar kappa level of agreement is seen in a study done by Chumber S et al.[15] which is 0.38. A higher kappa value is revealed by other similar studies done by Vergas H et al.[11] (kappa = 0.69, substantial or good agreement) and Redmi S et al.[14] (kappa = 0.633, substantial or good agreement).

Our study has found that higher weighted kappa values are in those with nodule sizes greater than 4 cm, ages less than 50 years, male sex and those cases with freehanded aspiration. A similar trend of higher kappa value for nodule size greater than 4 cm is seen in a study done by Vergas H et al.[11]

In our study, ultrasound is found to have 81.25% sensitivity, 56.67% specificity, 50% positive predictive value and 85% negative predictive value. These findings are lower compared to studies done by Periakaruppan et al.[16] where the sensitivity, specificity, NPV and PPV were 92.3%, 94.15%, 99.38% and 54.54%, respectively. A study done by Singapore W et al.[19] showed lower sensitivity (70.6%) and higher specificity (90.4%) and NPV (93.8%). Another study by Thattarakkal et al.[17] also showed higher specificity (89.6%), NPV (93.8%) and PPV (66.6%), but lower sensitivity (77.8%) (Table 8).

Table 8: A comparation of previously published studies to the current study.

Study and year	Country	Study Design	Sample size	M: F	Mean age	Concordance	Conclusion
Peri Karuppan, et al.[16]	India	Prospective	184 over 2 years	2 8 : 156	3rd -6th Decade	Not mentioned	TIRADS and Bethesda systems showed remarkable agreement, especially for the category II cases.
Vargas et al.[11]	Columbia	Prospective	180	1: 2	57	TIRADS2 and Bethesda II Kappa =0.690	TIRADS criteria have substantial agreement with the Bethesda system
Biswas et al.[13]	India	Prospective	69 over 1 year	1: 5.3	41.54	TIRADS 2 and Bethesda II	Careful interpretation of both systems is essential in classifying thyroid nodules to ensure appropriate management.
Chumber et al.[15]	India	Prospective	80	1 2 : 66	65% (20-40 years)	Categories 2-II and 5-V Kappa=0.380	The study shows a fair concordance between the TIRADS and TBSRTC. With higher agreement in categories 2/II and 5/V of both classification systems.
Regmi et al.[14]	Nepal	Prospective	54 over 9 months	4: 50	50.74	Kappa= 0.633	The study showed good concordance between ultrasound TIRADS categories and cytology TBSRTC categories. FNAC should only be recommended for suspicious nodules.
Present study	Ethiopia	prospective	92 over 6 months	1: 5	47.60	Categories TIRADS 5 -Bethesda V and TIRADS 2-Bethesda II	The TIRADS and Bethesda systems have a fair concordance rate, with maximum agreement seen between the two ends of the classification systems (TIRADS5-Bethesda V and TIRADS2-Bethesda II).

5. Conclusion

Our study revealed a fair concordance between cytologic diagnosis based on the 2017 TBSRTC and ultrasound diagnosis based on the 2017 ACR-TIRADS, with the highest concordance seen in the two ends of the classification systems (TIRADS 5-Bethesda V and TIRADS 2-Bethesda II). Careful interpretation of the ultrasound and cytology findings allows the treating physicians to decide which nodules need surgery and follow-up so that there will be no unnecessary surgical procedures and complications. There should be an institutional monitoring system for nodules with discordant ACR-TIRADS and TBSRTC categories, especially for those with extreme categories that are produced.

6. Recommendations

We recommend consistent use of the TBSRTC for reporting thyroid FNAC results in our institution and maximum attention should be paid in signing thyroid FNAC cases with discordant TIRADS categories. Our study showed a higher non-diagnostic rate and a relatively lower level of agreement between the two systems in the thyroid nodules aspirated with ultrasound guidance. So, ultrasound-guided FNAC should be done with experienced hands and it would be beneficial to develop interdepartmental interactions between pathology and radiology teams to optimize patient management. We recommend doing further studies with a larger sample size over multiple institutions so as to substantiate the results of our study.

7. Ethical Approval

All the procedures performed in this study were in accordance with the ethical standards of the university and department's research committee. Ethical clearance was obtained and informed consent was taken from participants.

8. Acknowledgments

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