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ORIGINAL ARTICLE

Application of Bethesda System for Reporting Thyroid Cytopathology in Correlation with Histopathological Diagnosis

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Abstract

***Background:** The classification system for thyroid by Bethesda employs six categories, accompanied by management recommendations and rates of malignancy. Its efficacy has been validated by reference centers, who have compared expected malignancy rates with those of their respective populations. However, there is currently a lack of comparable studies conducted in Iraq.*
***Objectives**: To evaluate the accuracy and Likelihood Ratio of FNA in diagnosis of patients with thyroid swellings by comparing Bethesda System for Reporting Thyroid Cytopathology (BSRTC) with histopathology.*
***Methods**: A retrospective study conducted in Al-Najaf-Iraq. Reports of 2050 fine-needle aspiration (FNA) for the period from June 2018 - June 2022 were reviewed and analyzed. Data of 220 patients who underwent surgery were compared to the cytohistological findings.*
***Results**: The risk of malignancy in BSRTC in this study was as follow; DC I non-diagnostic or unsatisfactory (40.0%), DCII benign (19.6%), DC III atypia of undetermined significance / follicular of undetermined significance (0.0%), DC IV follicular neoplasm or suspicious for a follicular neoplasm (30.4%), DC V suspicious for malignancy (44.1%), DC VI malignancy (97.4%), the prevalence of malignancy and benign lesions in BSRTC was (40.5%) and (59.5%), respectively. The, sensitivity was (78.3%), specificity (64.9%), positive predicted value (61.9%), negative predicted value (80.4%), and accuracy was (71.6%).*
***Conclusion**: The Bethesda System is good diagnostic tool in thyroid swellings and can be applied to the Iraqi population, since the diagnostic values and Likelihood ratio were closely to other results in many different literatures and within reference ranges.*

Keywords: Thyroid nodules, Diagnosis, Bethesda system, Histopathology

1. INTRODUCTION

Thyroid cancer is a common problem worldwide with an incidence of 586 202 cases for both sexes in 2020 with cumulative risk 0.68, for male new cases is 137 287 with cumulative risk 0.33, for female new cases is 448 915 with cumulative risk is 1.02. In recent years, the global incidence of thyroid cancer has risen. According to the World Health Organization reports, thyroid cancer is presently the ninth most prevalent type of cancer globally. The causes for this increase are unclear, but some experts suggest that changes in diagnostic practices and improved detection may be contributing factors. Additional possible factors include exposure to radiation, environmental pollution, and lifestyle and dietary changes. Though the overall survival rate for thyroid cancer is high, prompt identification and treatment are essential for optimal patient outcomes (1–3). FNAC is a fast, reliable, and minimally invasive diagnostic tool that has been widely used in clinical practice for several decades. FNAC involves using a small needle to aspirate cells from the thyroid gland, which are then examined under a microscope to determine whether they are benign or malignant. One of the key advantages of FNAC is the time consumed to be conducted where it is considered a rapid test; the entire procedure can usually be completed in a matter of minutes, with results available within a few days. This makes it an ideal choice for patients who require a rapid diagnosis or those who may be anxious about waiting for results. Another advantage of FNAC is its reliability. Studies have shown that it is highly accurate in diagnosing thyroid nodules, with sensitivity and specificity rates ranging from 75-98% and 70-100%, respectively with an accuracy of approximately 95%. This means that it is a highly effective tool for distinguishing between benign and malignant nodules. Additionally, FNAC is a cost-effective option for evaluating thyroid nodules. It is less expensive than many other diagnostic tests, making it a more accessible option for patients and healthcare systems alike (4).

Thyroid nodules represent a common problem for surgeons in addition to diagnostic challenge for cytopathologists. Thyroid nodules can be diagnosed in more than 60% of the general population, with an incidence of malignancy found to be approximately 5%. 3,254 new cases were diagnosed in the United Kingdom (UK) in 2017. Preoperative diagnosis of malignancy in thyroid nodules is a challenge facing clinicians to achieve an accurate

diagnosis, therefore, FNAC is a necessary tool in the diagnostic workup(5). Hypothyroidism, hyperthyroidism, cosmetic issues and compression are complications of Thyroid nodules and they might have risk for malignancy. Therefore, the accurate investigation of thyroid nodules is crucial. Currently, the role of fine-needle aspiration cytology is increasing regarding the treatment methods and its role in diagnosis of malignancy of thyroid nodules(6).

Thyroid nodule can be detected in 5% of individuals by palpation during thyroid examination and can be discovered in up to 60% of people who examined by ultrasonography. Most of thyroid nodules are benign, but might be the first sign of thyroid malignancy (7). Ultrasound Guided Fine Needle Aspiration (USFNA) is a widely accepted diagnostic tool used to evaluate and manage thyroid nodules. It is a cost-effective and safe technique that allows accurate diagnosis of thyroid nodules while minimizing the need for more invasive procedures. The Bethesda System for Reporting Thyroid Cytopathology (BSRTC) has played a crucial role in standardizing the interpretation and reporting of FNA results. The BSRTC provides a framework for classifying thyroid nodules based on the cytological characteristics of the extracted tissue samples, which improves the reproducibility and clinical significance of FNA results. The BSRTC has six diagnostic categories ranging from benign to malignant, each with specific criteria for diagnosis. This system enables clinicians to better stratify patient management and tailor treatment plans accordingly. For example, patients with benign nodules may only require periodic monitoring, while those with malignant nodules may require surgical intervention (8). Though FNAC is commonly used in the diagnosis, cytologically indeterminate thyroid nodules continue to represent a diagnostic challenge for cytopathologists. This results in definitive histologic diagnosis difficulties in a large number (10– 30%) of patients performing thyroidectomy (9).

Thyroid FNA practice requires collaboration among cytopathologists and clinicians, endocrinologists, radiologists, and surgeons, as well as communication with surgical pathology interpretations. Therefore, consistent diagnostic FNA categories are mandatory. While there are few difficulties in detection of most benign and malignant nodules, diagnostic difficulties occur when FNA samples are suboptimal to exclude a neoplastic lesions(10). Thyroid nodules commonly are benign colloid nodules /benign follicular nodules and less than 5% are malignant. Though a small percentage of thyroid nodules are malignant, the incidence

of both benign thyroid nodules and thyroid malignancy are increasing 2.4 folds in the last 3 decades. The incidence of thyroid nodules is increased because of good surveillance and ultrasound. However, the risk of malignancy and anxiety of patient encourage the need to accurately diagnose thyroid nodules(11).

Fine needle Aspiration (FNA) has been an essential part of thyroid nodule diagnosis and workup since the late 1970s(12). Previously, terminology for thyroid Fine Needle Aspiration cytology has been differed significantly from one laboratory to another, making confusion in many cases and impeding the sharing of clinically meaningful results among laboratories (13), To improve collaboration between cytopathologists and clinicians, the Bethesda Cytopathology Reporting System (BSRTC) was introduced. The BSRTC classifies fine needle aspiration cytology (FNAC) findings into six categories: nondiagnostic (DC I), benign (DC II), atypical or follicular lesions of undetermined significance (DC III), follicular neoplasia or suspected follicular neoplasia (DC IV), suspected malignancy (DC V), and malignant (DC VI). The BSRTC recommends various clinical management strategies based on the classification, including repeating FNA (DC I and DC III), clinical observation (DC II), and surgical treatment such as lobectomy (DC IV) and total thyroidectomy (DC V and DC VI). Despite the introduction of the BSRTC in 2007 to improve the accuracy of FNAC, there have been limited studies conducted in Iraq to evaluate its effectiveness as a diagnostic tool. Thus, our study was conducted to evaluate the accuracy and likelihood ratio of FNA in classifying patients with thyroid nodules by comparing the BSRTC system with the histological diagnosis, which serves as the gold standard for surgically excised nodules. We also aim to determine the risk of malignancy in thyroid nodules based on the BSRTC category to provide future guidance for treatment options and management of these patients (13,14),.

The sensitivity of thyroid FNA ranges from 65% to 99%, and the specificity from 72% to 100%. These results of FNA can be affected by the experience of the cytopathologists, diagnostic difficulty, and classification of suspicious lesions(2). Using Bethesda system, cytopathologists can share their interpretations with the referring physicians in terms that are concise, clear, and clinically useful(15).

Fine needle aspiration cytology has greatly improved the clinical treatment options for thyroid tumors. However, FNA has limitations not only due to misdiagnosis, but more

importantly the inability to differentiate between benign and malignant follicular lesions in the absence of nuclear evidence of papillary carcinoma. Diagnosis of follicular tumor includes different types of thyroid lesions like cellular adenomatoid nodules, follicular adenoma, and carcinoma. Furthermore, interpretation of the follicular type of papillary carcinoma on FNA may be difficult when classic nuclear features of papillary thyroid carcinoma are absent. In such cases accurate preoperative diagnosis of follicular lesion that are suggestive of papillary carcinoma can favor the conservative surgical treatment till the definitive diagnosis is reached which in turn determine the final treatment option

Follicular neoplasm and Hurthle cell neoplasm are uncommon thyroid diseases and their cytological diagnosis is challenging in comparison with papillary thyroid carcinoma (PTC) which displays a cytological accuracy of more than 90%. Additionally, cytological differentiation between benign and malignant nodules is impossible in Follicular Neoplasm and Hurthle cell neoplasm cases(16). Another limitation of thyroid cytology is the occurrence of false positive and false negative results, especially in small tumors and cystic degeneration or inflammation of the surrounding thyroid tissue. In addition, there is a group of lesions that overlap with benign and malignant features. For instance, colloid goiter and follicular neoplasms may be difficult to be distinguished (4).

2. METHODOLOGY

This was a cross sectional study includes 2050 FNA cases of thyroid lesions were collected from medical records from June 2018 to June 2022 in the Department of Pathology of Al-Sadr Medical Teaching City and also from two other private central Laboratories, Al-Najaf, Iraq. The FNA cases were categorized according to the Thyroid Bethesda system for Reporting Thyroid Cytopathology (BSRTC) 2017(15). 220 out of 2050 cases were histologically diagnosed and selected. Cytohistological correlation was performed for them.

Statistical analysis was done using SPSS Software Version 22 and Microsoft Office Excel 2010. Data were inserted and Qualitative (continuous variables) like Age, and Quantitative (Nominal) Variable like Gender were created. Mean, Standard Deviation (SD) and cumulative percentage were calculated for continuous variables like age. Gender Variable was correlated with Histology Variable by Crosstabulation. Categorical variables like Bethesda

System and Histology were expressed as frequencies and percentages. Pearson Chi-Square test was used to calculate the Likelihood Ratio. Likelihood Ratio < 1 indicates the Test statistically relevant and P-value < 0.05 regarded as significant.

The diagnostic values (sensitivity, specificity, positive predictive value, negative predictive value, and accuracy) and risk of malignancy for Bethesda system for reporting thyroid cytopathology that correlated to histological cases were calculated by applying Receiver operating characteristics (ROC) Curve and Crosstabulation.

The FNA cases interpreted as nondiagnostic and follicular lesions of undetermined significance were excluded from calculations because it is difficult to classify follicular lesions of insufficient or undetermined significance into benign or malignant cytologic categories. True negative cases were defined as cases with benign cytology and surgical histology. Follicular neoplasia or suspicious follicular neoplasia, suspicious malignant cases that were malignant on final histology were assigned as true positive cases. Malignant or suspected malignant tumor cases diagnosed with cytological manifestations of FN/SFN or malignant diagnosed as benign on surgical excision and appeared malignant on final histopathology were interpreted as false positive results. Cases with benign cytology but malignant on histopathology were considered as false negative

In our study, we assumed that follicular lesions as follow ; follicular adenoma and cellular adenomatoid nodule as benign whereas follicular carcinoma regarded as malignant and low risk lesions like non-invasive follicular thyroid neoplasm with papillary like nuclear features (NIFTP) and Well differentiated thyroid tumor of uncertain malignant potential (WDTUMP) / Follicular thyroid tumor of uncertain malignant potential (FTUMP) and hyalinized trabecular tumor (HHT) regarded as malignant(17) and medullary thyroid cancer, Anaplastic/undifferentiated and lymphoma also malignant , for proper calculation of sensitivity, specificity , PPV,NPV , FPR , FNR and accuracy because it is difficult to exclude them or regarding them as benign or malignant lesion.

Cross-tabulation and ROC curve with area under curve (AUC) were applied to evaluate the validity of Bethesda System categories after exclusion (non-diagnostic, follicular lesion of undetermined significance) and histopathological cases. The accuracy was interpreted as

follows: 50-60% indicates poor performance, 60-70% indicates Fair, 70-80% indicates good, and 80-90% very good and 90-100% indicates excellent performance.

Validity parameters including sensitivity, specificity, PPV, NPV and accuracy were calculated according to the standard equations

3. RESULTS

The study included 2050 thyroid FNA cases. Age of the patients ranged between 8 – 90 years with a mean of 41.90 ± 13.6. Females were dominant; contributed for (80.2%) with a female to male ratio of almost 4.1 to one (**Table 1**). In 2050 FNA cases, the BSRTC was non diagnostic or unsatisfactory (DC I) in 203 (9.9%), benign (DC II) in 1344 (65.6%), atypia /follicular lesion of undetermined significance (DC III) in 85 (4.1%), follicular neoplasm or suspicious for a follicular neoplasm (DC IV) in 121 (5.9%), suspicious for malignancy (DC V) in 136 (6.6%), and malignant (DC VI) in 161 (7.9%), (**Table 2**).

However, among the 2050 cases of FNA, only 220 cases did have histopathology reports, among them, 131 (59.5%) were benign and 89 (40.5%) were malignant. Furthermore, among females, benign thyroid swellings (BTS) reported in 111 (60.0%) while malignant thyroid swellings (MTS) in 74 cases (40.0%). Among males, BTS reported in 20 cases (57.1%) while MTS in 15 cases (42.9%), with no significant difference between both genders regarding the distribution of benign and malignant lesions , (P. value >0.05), (**Table 3**). The risk of malignancy in BSRTC is demonstrated in (**Table 4**) where DC I contributed for (40.0%), DC II(19.6%), DC III (0.0%), DC IV (30.4%), DC V (44.1%) and DC VI contributed for (97.4%). As shown in (**Table 5**), distribution categories of BSRTC among the 220 surgical cases correlated with definitive histological diagnosis, revealed that most of the 15 DC I cases were benign in which multinodular goiter (MNG) is predominant, while malignant cases were less common in which papillary thyroid carcinoma (PTC) cases were the predominant. Majority 56/92 DC IIcases were benign and MNG was the predominant, less frequently, follicular adenoma (FA) and Hashimatos thyroiditis, but malignant cases were present in 19 /92 cases, predominantly PTC cases. All the 8 DC III cases were benign with predominance of MNG and Hashimatos thyroiditis. Regarding the 33 DC IV cases; benign lesions were the most common; MNG and FA cases were the commonest, while almost one-third of cases were malignant with PTC predominant. Among the 34 DC V cases; more than 50% were benign in which MNG with

hyperplastic nodules were predominant and to less extent Hashimatos thyroiditis, while PTC cases were the commonest malignant cases. Majority of the 38 malignant (DC VI) cases were malignant (PTC). In order to calculate the sensitivity, specificity, positive predictive value, negative predictive value, accuracy, prevalence; BSRTC DC II, was considered as benign (Negative test) while DC IV, V and VI considered as malignant (Positive test), category I (non-diagnostic or unsatisfactory) and category III (atypia / follicular lesion of undetermined significant) were excluded from calculation, giving a total of 197 cases (**Table 6**). Results of this analysis revealed sensitivity, specificity, accuracy, PPV and NPV of 78.3%, 64.9%, 70.6%, 61.9% and 80.4%, respectively. Moreover, receiver operating characteristics (ROC) curve analysis (Figure 1) revealed an area under the curve (AUC) of 0.716 indicated good performance. On the other hand, according to ROC curve the false positive rate (1-specificity) was 35.1%, (**Table 7**).

Table 1. Age and gender distribution of the patients with thyroid lesions (N=2050)

Variable		
Age (year)	Mean (SD) years	41.9 (13.6)
	Range	8 - 90
Gender	Female, n (%)	1645 (80.2)
	Male, n (%)	405 (19.8)
	Female to Male ratio	4.1
	Total	2050 (100.0)

SD: standard deviation

Table 2. Distribution of FNA cases according to Bethesda system categories (N=2050)

Category	No.	%
Non diagnostic or unsatisfactory (DC I)	203	9.9
Benign (DC II)	1344	65.6
Atypia /follicular lesion of undetermined significance (DC III)	85	4.1
Follicular neoplasm or suspicious for a follicular neoplasm (DC IV)	121	5.9
Suspicious for malignancy (DC V)	136	6.6
Malignant (DC VI)	161	7.9
Total	2050	100

Table 3. Distribution of benign and malignant lesions that reported on histology according to gender (N=220)

Category	Benign		Malignant		Total	
	No.	%	No.	%	No.	%
Female	111	60.0	74	40.0	185	100.0
Male	20	57.1	15	42.9	35	100.0
Total	131	59.5	89	40.5	220	100.0
Chi-square = 0.02, P. value = 0.898 , not significant						

Table 4. Risk of malignancy in different Bethesda system categories

Diagnosis	Benign		Malignant		Total	
	No.	%	No.	%	No.	%
DC I	9	60.0	6	40.0	15	100.0
DC II	74	80.4	18	19.6	92	100.0
DC III	8	100.0	0	0.0	8	100.0
DC IV	20	60.6	13	39.4	33	100.0
DC V	19	55.9	15	44.1	34	100.0
DC VI	1	2.6	37	97.4	38	100.0
Total	131	59.5	89	40.5	220	100.0

Table 5. BSRTC Categories with Definitive histological diagnosis

Definitive histological diagnosis		DCI (n=15)	DC II (n=92)	DC III (n=8)	DC IV (n=33)	DC V (n=34)	DC VI (n=38)
MNG		5	56	3	11	15	1
De Quervain thyroiditis		1	2	1	1	1	0
Hashimatos thyroiditis		1	6	3	2	2	0
Grave's disease		1	1	0	0	0	0
Follicular/Hurthle cell adenoma		1	8	1	7	0	0
NIFTP		0	4	0	1	2	2
Haylinized trabecular tumor		0	1	0	0	1	0
WDTUMP		0	1	0	3	2	0
FTUMP		0	0	0	0	0	1
PTC:	Microcarcinoma	0	3	0	2	0	1
	Follicular variant	0	1	0	0	0	1
	Encapsulated follicular variant	0	0	0	0	0	1
	Classic variant	6	6	0	5	10	29
Undifferentiated/Anaplastic carcinoma		0	0	0	1	1	1
Medullary thyroid cancer		0	2	0	0	0	0
Lymphoma	MALT type	0	1	0	0	0	0
	DLBCL + hashimatos thyroiditis	0	0	0	0	0	1

Table 6. Correlation between FNA (BSRTC II, IV, V, and VI) and histology

FNA	Histology				Total	
	Benign		Malignant			
	No.	%	No.	%	No.	%
Benign (DC II)	74	80.4	18	19.6	92	100.0
Malignant (DC IV,DC V & DC VI)	40	38.1	65	61.9	105	100.0
Total	114	57.9	83	42.1	197	100.0
Chi-square = 34.3, P. value <0.001 , significant						

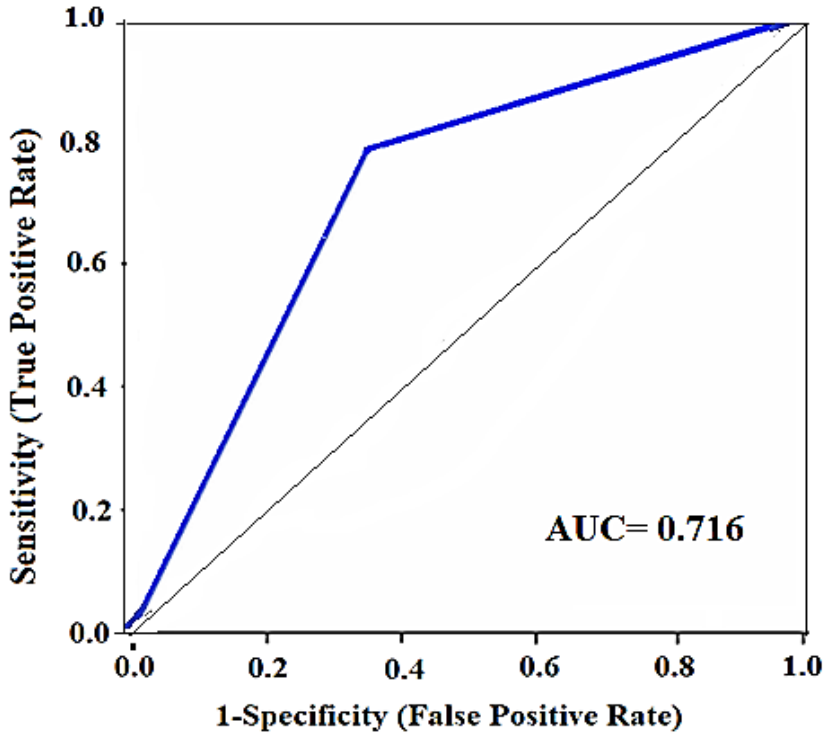

Figure 1. ROC Curve analysis for the validity of Bethesda System

Table 7. Validity parameters of Bethesda System

Parameter	Value
AUC	0.716
Sensitivity	78.3%
Specificity	64.9%
Accuracy	70.6%
PPV	61.9%
NPV	80.4%
FPR	35.1%
FNR	21.7%

PPV: Positive predicted value, NPV: Negative predicted value

FPR: False positive rate, FNR: False negative rate

4. DISCUSSION

Fine needle aspiration (FNA) cytology is considered the gold standard in the diagnosis of thyroid lesions. Ultrasound, radioisotope scan, and various other tests are implemented for assessment of thyroid lesions before the choice of surgical option, Nonetheless, FNAC is the most accurate and low cost test for rapid diagnosis of thyroid lesions (4).

The goal of thyroid FNA is to successfully distinguish between benign and malignant lesions and to stratify patients who require surgical intervention. The standardized nomenclature of the Bethesda system facilitates better communication and understanding between pathologists and clinicians when reporting thyroid FNA smears. The systematic approach of the Bethesda system enables each of the six categories to represent the risk of malignancy, assisting clinicians in making decisions regarding the appropriate management for their patients. (17).

Few studies were conducted in Iraq to evaluate the sensitivity and specificity with PPV and NPV of FNA in differentiation of patients with thyroid nodules by comparing BSRTC with the gold standard histological diagnosis of surgically excised nodules and to determine risk of malignancy in the BSRTC categories to guide the follow up.

Due to the role of cytological results - they should have a low false negative rate, acceptable sensitivity and specificity for diagnosis of malignancy with a high negative predictive value. In our study, the cases reported as ' suspeciuos of follicular neoplasm / follicular neoplasm' in addition to ‘suspicious of malignancy’ and 'malignancy' on cytology were included in the malignant category for statistical analysis because both lead to surgical management (lobectomy or near total thyroidectomy). In addition, we excluded diagnostic category I and III for calculation of the sensitivity, specificity, positive predicted value, negative predicted value, accuracy, likelihood ratio.

In the current study, there was a female predominance giving a female percentage 80.2% and male percentage 19.8%. The age of patients ranged from 8 years to 90 years old and the mean age was 41.90 ± 13.4 (standard deviation), M:F ratio 4:1 and these results was approximately close to results in the study that conducted by Aljebori et al (18) in which females were 186 (84.16%), and males 35 (15.84%), females were more than males in a ratio of 5.31/1, the mean age of patient was 45.67±3.1 years. Another sudy performed by E. A.

Sinna and Ezzatet (4), the age of patients ranged from 14 to77 years, with median of 44 years, M:F ratio was 5.2:1. The study conducted by R. Alhassan et al (19) revealed that female's percentage 87.8% and 12.2% was males , the study population's mean (SD) age was 43.7 (13.3) years, with a median of 42 years, and the minimum age being 18 years and the maximum age was 86 years.

Our study revealed that benign lesions (59.5%) higher than malignant lesion (40.5%) in histopathology and these results were lower than results in Sulayvani, Farhad K. in which 81.6% benign and 18.4% malignant.(20)

In our study depicted the frequencies of each diagnostic category in BSRTC. were DC I in 203 (9.9%), DC II in 1344 (65.6%), DC III in 85 (4.1%) ,DC IV in 121 (5.9%), DC V in 136 (6.6%), DC VI in 161 (7.6%). these results were closely to results published in many literatures(19,21,22). For instance, Alhassan et al (19) found 101 (7.4%) as non-diagnostic or unsatisfactory, 1001 (73.7%) benign, 119 (8.8%) as atypia of undetermined significance or follicular lesion of undetermined significance, 31 (2.3%) as follicular neoplasm or suspicious for a follicular neoplasm, 52 (3.8%) as suspicious for malignancy, 55 (4%) as malignant. This reflects the appropriate diagnosis of thyroid lesions by BSRTC and appropriate recommended management.

The risk of malignancy in BSRTC in this study was as follow: DC I non-diagnostic or unsatisfactory (40.0%), DCII benign (19.6%), DC III atypia/follicular lesion of undetermined significance (0.0%), DC IV follicular neoplasm or suspicious for a follicular neoplasm (30.4%), DC V suspicious for malignancy (44.1%), DC VI malignancy (97.4%).

In comparison to published literatures in European Thyroid Journal and Saudi Journal of Medicine and Medical Sciences (21,23), the rate of malignancies within BSRTC. As a result, the risk of malignancy in DCIII A.U.S was 0.0 as compared to 50% in Zarif et al. study. and 12% in Reuters et al. study (21,23) related to results of final histology which were only multinodular goiter, Hashimatos thyroiditis, De Quervain thyroiditis and follicular adenoma, no malignancy was detected, therefore, the risk of malignancy was zero due to the fact that the number of cases with A.U.S that submitted for histological evaluation was low where they were only 8 cases, and in DCV suspicious of malignancy 44.1% as compared with Zarif et al. study 95.7% and Reuters et al. study 72.5% (21,23) this related to final histological

diagnosis which were Multinodular goiter, Hashimatos thyroiditis, De Quervain thyroiditis, hyalinized trabecular tumor, NIFTP, WDTUMP, PTC and undifferentiated carcinoma.

As a result, out of 34 cases in DCV, only 0.55% were benign and 0.44% were malignant cases. Therefore, the risk of malignancy was lower than published literatures. The risk of malignancy in other categories was closely to results in comparison to referred literatures.

According to literature, the sensitivity of thyroid FNA ranges from 65% to 99% , and the specificity from 72% to 100% (2). in a study conducted by Machała et al. in 2018 (2) the sensitivity was 60.28% and specificity was 98.05%(2). In our study, sensitivity was 78.3%, specificity was 64.9%. The reasons for lower sensitivity can be due to combination of the following: cytopathologist variability, lower number of cases, classification of suspicious lesions and diagnostic difficulty of using FNAC in certain thyroid lesions

In our study the accuracy rate was good (70-80%). A previous study conducted by Naz et al. reported a positive predictive value of 56.3%, a negative predictive value of 88.9%, and accuracy of 80.3% were reported (24), in other study, Gabalec et al. (25)estimated a positive predictive value to be 34–100%, whereas a negative predictive value was 83–100%.

the positive likelihood ratio (LR) was (2.2) and negative likelihood ratio was (0.61). It is worth mentioning that The probability of a particular test result is the same for those with and without the disease when the likelihood ratio is 1.0. If the likelihood ratio is greater than 1.0, the test result is more likely to occur in those with the disease. If the likelihood ratio is less than 1.0, the test result is less likely to occur in those with the disease. As the likelihood ratios move further from 1.0, their association with the presence or absence of the disease becomes stronger. Tests with high LR+ and low LR− have better discriminating ability, and tests with LRs >10 or <0.1 can help establish or exclude a diagnosis. This highlights the significance of BSRTC in differentiating and triaging thyroid swellings.

The probability of a positive or negative test result is the same for individuals with and without the disease when the likelihood ratio is 1.0. Likelihood ratios greater than 1.0 suggest that individuals with the disease are more likely to have a positive test result, while ratios less than 1.0 suggest that individuals without the disease are more likely to have a negative test result. The magnitude of the association between the test result and disease presence or absence increases as likelihood ratios move away from 1.0. Highly discriminative

tests have very high LR+ and very low LR−, with tests having LRs >10 or <0.1 being particularly useful in diagnosis confirmation or exclusion(5). The application of BSRTC in triaging and differentiating thyroid swellings is therefore critical.

5. CONCLUSIONS

Bethesda System showed good diagnostic performance of with sensitivity, specificity and accuracy of (78.3%), (64.9%), and (71.6 %), respectively . However, thyroid FNA remains a strong screening modality for thyroid nodules in a multidisciplinary setup of endocrinologists, surgeons and pathologists, and its results can guide clinical managements. So that, Bethesda System is good diagnostic tool in thyroid swellings and can be applied to the Iraqi population, since the diagnostic values and Likelihood ratio were closely to other results in many different literatures and within reference ranges.

Ethical Approval:

All ethical issues were approved by the author. Data collection was in accordance with the World Medical Association (WMA) Declaration of Helsinki, 2013 for the ethical principles of researches involving human. Signed informed consent was obtained from each participant and data were kept confidentially.

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