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Comparative Cross Sectional Study Between Accuracy of Ultrasonography and Cytology in Diagnosis of Thyroid Cancer with Final Histopathology Results

Abdalwahab R. Abdalwahab[1], Abdelaziz Tareq Osman[1], Tarek Khairy[1], Osman A. Algadir Ali[2], Mai Gad[3], Mona Alabrak[3], Shady Mohammed Elsebai[4], Reda Tobashy[4], Amal A. ALI[5], Mohamed Elmahdy[6]*, Mohamed Atef Elkordy[1]

***Corresponding author:**
Mohamed Elmahdy, M.D.
Department of Surgical Oncology
Nasser Institute Hospital for Research and Treatment, Egypt
E-mail: melmhdy@Aol.com

[1]Department of Surgical Oncology, National Cancer Institute, Cairo University, Egypt
[2]Department of Surgery, Faculty of Medicine, Al_Butana University, Gizera, Sudan
[3]Department of Surgical Pathology, National Cancer Institute, Cairo University, Egypt
[4]Department of Diagnostic and Interventional Radiology, National Cancer Institute, Cairo University, Egypt.
[5]Faculty of Applied Medical Science, Saudi Arabia
[6]Department of Surgical Oncology Nasser Institute Hospital for Research and Treatment, Egypt

ABSTRACT

Background: Ultrasonography and FNAC are two simple methods for diagnosing thyroid nodules. Both of them have false positive, false negative results and also have different sensitivity, specificity and diagnostic accuracy if they are compared with final histopathology.
Patients and Methods: A retrospective study was conducted among 495 patients of NCI, Cairo University, aged (9-89) with a female/male (F/M) ratio of 4:1 during the period from 2016 to 2021 to assess the validity of neck ultrasound and FNAC to diagnose thyroid cancer through their standardization with final histopathology of a given specimen after thyroidectomy.
Results: The sensitivity, specificity, PPV, NPV diagnostic accuracy of ultrasonography were 80.06%, 68.55%,79.80%, 68.91% and75.55%, respectively while the sensitivity, specificity, PPV, NPV and diagnostic accuracy of FNAC were 93.69%, 72.50%, 86.30%, 86.13% and 86.25%, respectively.
Conclusion: A proper protocol like TIRAD System of the American Thyroid Association (ATA) and FNAC according to The Bethesda System are warranted in the institute's framework for the future practice.
Keywords: thyroid nodule, thyroid cancer, ultrasonography, TIRADS, fine needle aspiration cytology, Bethesda

INTRODUCTION

Thyroid nodules are common disease and has higher incidence among females with rare incidence of malignant nodules (1). Final histopathology is the ideal method in the diagnosis of thyroid nodules; however, preoperative accurate diagnosis is essential for proper planning of treatment (2). FNAC is one of the most reliable tools in diagnosis of thyroid nodules which become even

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more precise after adding genetic tests (3). Among reviews; sensitivity, specificity and accuracy of FNAC have been reported as high as 65-98%, 72-100 and 95% respectively (2). Neck ultrasound is considered valuable tool in accurate diagnosis of thyroid nodules based on TIRADs classification, but it is operator dependent (4). The present study aims to assess the validity of neck ultrasound and FNAC among National cancer institute, Cairo university experience through their standardization with final histopathology of a given specimen after thyroidectomy and to decide if neck ultrasound can be used as a reliable alternative to the more invasive, expensive and time consuming FNAC.

MATERIAL AND METHODS

A retrospective study consists of 495 patients were enrolled in the department of Head and Neck, National Cancer Institute (NCI) within the period from March, 2016 to March, 2021. The targeted patients presented for the first time with thyroid nodules. All of the selected patients were subjected to US, FNAC and finally surgical treatment. Patients excluded from this study were Patients who had recurrent thyroid cancer, Patients who performed previous thyroid surgery and Patients with incomplete medical records. A high spatial resolution ultrasonography machine was used for baseline assessment according to the TIRADS results. Neck ultrasound was carried out for all patients of both sexes under study. It is usually done in supine head and neck position. The neck was scanned in sagittal transverse and oblique sections to optimally visualize both lobes of thyroid, isthmus, carotid arteries, internal jugular veins, neck lymph node, as well as any abnormal anatomical changes. The ultrasonography examination of the thyroid gland was performed by the senior sonographer, Radiology department in NCI. FNAC was used for the patients after being examined by ultrasonography and categorized according to TIRADS. The disposable needle used for thyroid FNAC was a Standard (23/24) gauge, noncutting beveled edge needle. It was attached to a 10 ml syringe. The needle was introduced to the center of thyroid nodule, and then sucked gently. Two drops of the aspirate/fluid in the syringe were taken over a clean glass slide. The slide making procedure was repeated once more and after smearing the second slide, these slides were put in a jar containing absolute alcohol for fixation, these two slides in alcohol along with container were sent to Pathology department for cytopathological assessment. After obtaining the US and FNAC, the patients were subjected to either hemithyroidectomy or total thyroidectomy. The final thyroid specimen for each patient was sent for surgical pathology unit. The sensitivity and specifity of the US and FNAC results were compared to their corresponding histopathological findings.

RESULTS

Out of total 495 patients, 96 patients (19.39%) were males and 399 patients (80.61%) were females. The female/male (F/M) ratio is 4:1. The youngest patient was 9 years old and the eldest patient was 89 years old, 371 patients (74.92%) were less than 55 years old while 124 patients (25.1%) were more than 55 years old. After performing neck ultrasound among our cases; 139 cases had benign looking nodules (TIRADs 2); 11.5% were male and 88.5% were female with no recommendations to perform FNAC, while 356 cases had suspected malignant looking nodules (TIRADs 3:5); 22.5% were male and 77.5% were female with recommendations to perform FNAC (*fig. 1*). When comparing pre-operative ultrasound findings with the final pathological findings we found that among the 356 cases who had suspected malignant looking nodules (TIRADs 3:5) 241cases were reported as malignant after performing thyroid surgery on histopathology. In contrast, the diagnostic results of ultrasonography revealed that 139 cases had benign looking nodules (TIRADs 2), out of which 60 were reported as malignant on histopathology. The validity of neck ultrasound according to the final histopathological result showed that ultrasound sensitivity 80.06%, specificity 68.55%, positive predictive value 79.80%, negative predictive value 68.91% and accuracy 75.55% (*table 1*). Out of 356 patients who underwent FNAC for diagnosis according to the Bethesda system; 57 patients (16.66%) had non diagnostic sample (22.81% were male and 77.19% were female), 58 patients (16.95%) had benign sample (24.13% were male and 75.86% were female), 26 patients (7.6%) had follicular lesion of undetermined significant (FLUS) (15.38% were male and 84.61% were female), 57 patients (16.66%) had follicular neoplasm (26.31% were male and 73.68% were female), 140 patients (40.93%) had suspicious malignant sample (25% were male and 75% were female) and 18 patients (5.26%) had malignant sample (33.33% were male and 66.66% were female) (*fig. 2*). Among 58 cases that were reported as benign, out of which 16 cases (17.39%) were found in the age group < 55 years while 42 cases (20.28%) were found in the age group ≥ 55 years, among 241 cases that were reported as malignant, out of which 76 cases (82.60%) were found in the age group <55 years while 165 cases (79.71%) were found in the

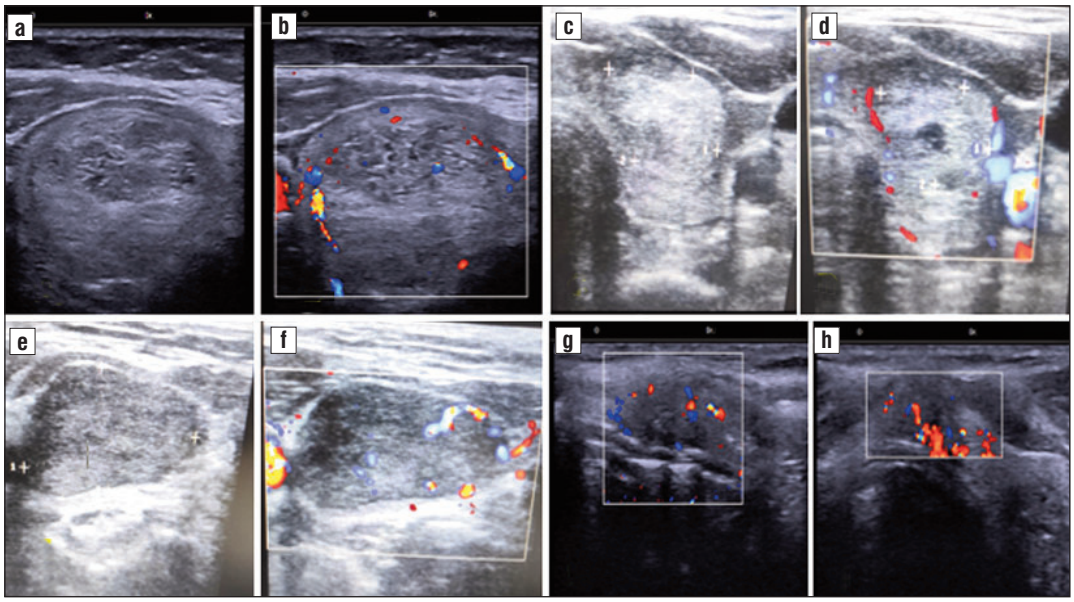

Figure 1 - Ultrasound findings of thyroid lesions among our cases.

Table 1 - Patients' characteristics, ultrasound and FNAC findings

Characteristic	Number of patients (%)
Age (years)	
Less than 55 years old	371 (74.9%)
More than 55 years old	124 (25.1%)
Gender	
female	399 (80.61%)
male	96 (19.39 %)
Ultrasound findings	
Benign looking nodules (TIRADs 2)	139 (28%)
Final histopathology after performing surgery for those 139 patients with benign looking nodules on ultrasound;	
Benign histopathology	79 (56.8%)
Malignant histopathology	60 (43.2%)
Malignant looking nodules (TIRADs 3:5)	356 (72%)
Final histopathology after performing surgery for those 356 patients with malignant looking nodules on ultrasound;	
Benign histopathology	115 (32.3 %)
Malignant histopathology	241 (67.7 %)
Ultrasound sensitivity	80.06 %
Ultrasound specificity	68.55 %
Ultrasound positive predictive value	79.80 %
Ultrasound negative predictive value	68.91 %
Ultrasound accuracy	75.55 %
FNAC findings among 356 patients who had malignant looking nodules on ultrasound	
Non- diagnostic	57 (16.66 %)
Benign	58 (16.95 %)
Follicular lesion of undetermined significant (FLUS)	26 (7.6 %)
Follicular neoplasm	57 (16.66 %)
Suspected malignant	140 (40.93 %)
Malignant	18 (5.26 %)
Final histopathology after performing surgery for those 241 patients with non-benign findings on FNAC (FLUS or follicular neoplasm or suspected malignant or malignant);	30 (12.45 %)
Benign	211 (87.55 %)
	170 (80.56 %)
Malignant	21 (9.95 %)
- Papillary thyroid carcinoma	7 (3.31 %)
- Follicular thyroid carcinoma	8 (3.79 %)
- Medullary thyroid carcinoma	5 (2.36 %)
- Anaplastic thyroid carcinoma	
- Thyroid lymphoma	
FNAC sensitivity	93.96 %
FNAC specificity	72.50 %
FNAC positive predictive value	86.30 %
FNAC negative predictive value	86.13 %
FNAC accuracy	86.25 %

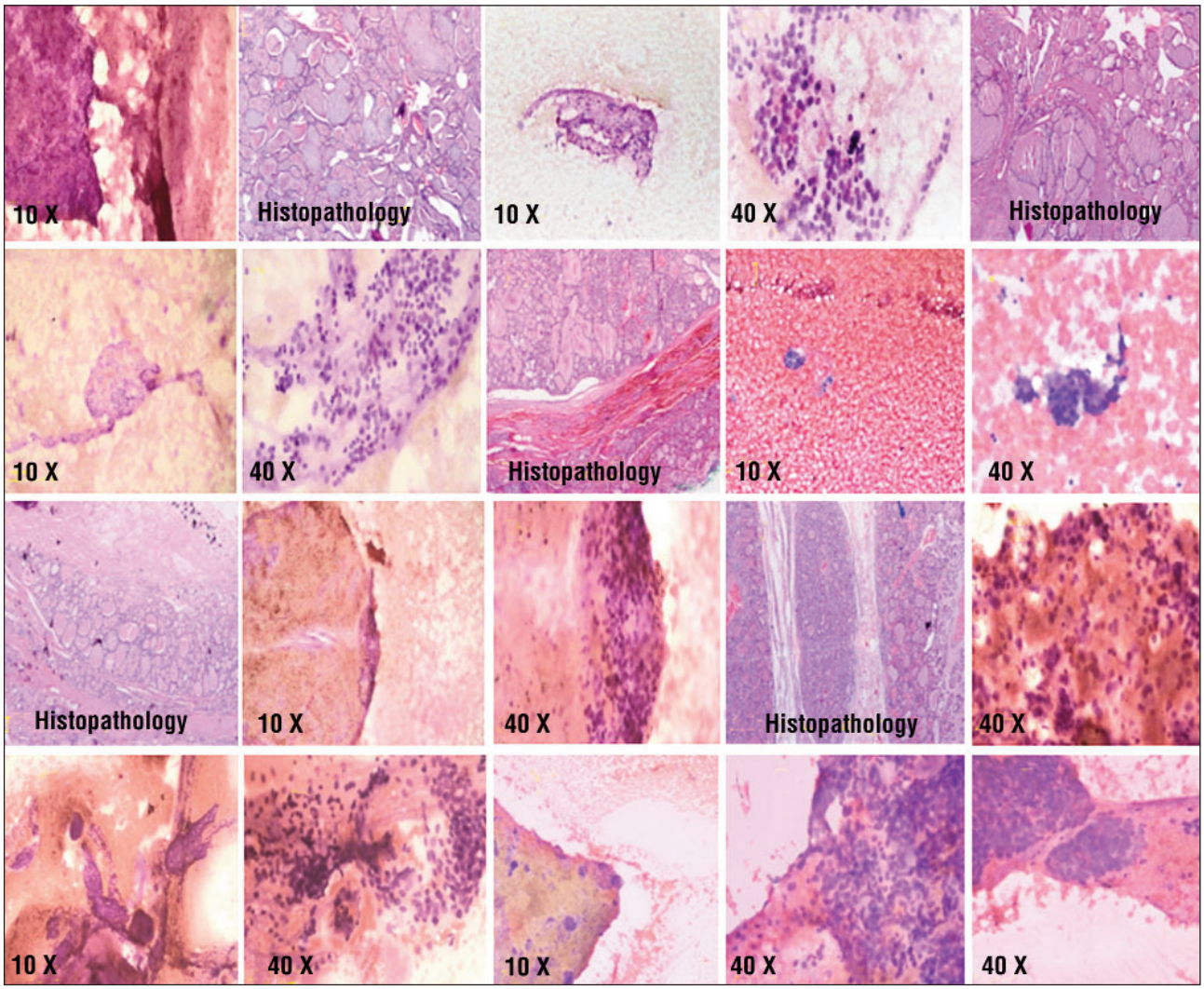

Figure 2 - Pathological findings of FNAC in thyroid lesions among our cases.

age group ≥ 55 years. Among 241 patients who were categorized under (suspicious AUS/FLUS, follicular neoplasm/suspicious follicular neoplasm, suspicious malignant) underwent (hemi/total) thyroidectomy. The specimen were sent to Histopathology department revealing that 30 patients (12.44%) were found to be benign and 211 (87.55%) were proven malignant on histopathology with different thyroid cancer variants: PTC (170; 80.56%), FTC (21; 9.95%), MTC (7; 3.31%); ATC (8; 3.79%), and lymphoma (5; 2.36%). The validity of FNAC according to the final histopathological result showed that FNAC sensitivity 93.96%, specificity 72.50%, positive predictive value 86.30%, negative predictive value 86.13% and accuracy 86.25 % (*table 1*).

DISSCUSSION

Thyroid nodules have a higher incidence in females (5,6). There is no consensus about validity of cytological assessment of thyroid nodules among reviews and this was reflected in the wide range for sensitivity, specificity of FNAC regarding thyroid neoplasms (7,8). Sharma et al stated that FNAC sensitivity was 89.5%, specificity was 98%, PPV was 84.6%, and NPV was 98.6% with overall diagnostic accuracy was 97% (9). Hajmanoochehri et al reported that FNAC sensitivity was 95.2%, specificity was 68.4%, PPV was 83.3%, and NPV was 89.6% with overall diagnostic accuracy was 85.14% (10). Vasudev et al reported that FNAC sensitivity was 96%, specificity was 66%, PPV was 66%, and NPV was 96% with overall diagnostic accuracy was 90% (11). Shih et al reported that FNAC sensitivity was 100%, specificity was 17.6%, PPV was 62.2%, and NPV was 100% (12) (*table 2*). Among our cases we reported that For FNAC vs. final histopathology, the sensitivity and specificity were calculated to be 93.69% and

Table 2 - Comparison of present study vs. previous studies.

Study	Gupta, et al. 2016 (n=100)	Sharma 2015 (n=724)	Hajmanoochehri & Rabiee 2016 (n=101)	Vasuddev et al. 2016 (n=456)	Shih et al. 2019 (n=240)	Youssef et al. 2020 (n=50)	Bhlse et al. 2020 (n=75)		Present Study 2022 Egypt (n=495)	
Diagnosis	US	FNAC	FNAC	FNAC	FNAC	US	US	FNAC	US	FNAC
Sensitivity	90%	89.5%	95.2%	96%	100%	100%	86.66%	93.3%	80.06%	93.69%
Specificity	98.8%	98%	68.4%	66%	17.60%	94.12%	91.66%	95%	68.55%	72.50%
PPV	90%	84.6%	83.3%	66%	62.20%		72.22%	82.23%	79.80%	86.30%
NPV		98.6%	89.6%	96%	100%		96.49%	98.27%	68.91%	86.13%
Accuracy		97%	85.14%	90%		96%	90.66%	94.66%	75.55%	86.25%

72.50%, respectively. Reported PPV, NPV were 86.30% and 86.13%, respectively. The overall diagnostic accuracy was 86.25%, respectively. Regarding accuracy of neck ultrasound in accurate diagnosis of thyroid malignancy; Bhise et al reported that ultrasound sensitivity was 86.66%, specificity was 91.66%, PPV was 72.22%, and NPV was 96.49% with overall diagnostic accuracy was 90.66% (13). Among our cases we reported that for ultrasonography vs. final histopathology, the sensitivity and specificity were calculated to be 80.06% and 68.55%, respectively. Reported PPV, NPV were 79.80% and 68.91% %, respectively. The overall diagnostic accuracy was 75.55%, respectively. According to ATA recommendation, patients under TR1 and TR2 should be excluded from the FNAC and by default from this study, apart from small portion of patients who enrolled the study based on their clinical findings .Thus, a proper assessment of patients at risk like elder age patients, positive family history patients and previous known history of radiation as well as the size and number of the nodule(s), which can make TR2 more suspicious and finally may change the final results of the validity. Thus, it will be advisable to enroll benign cases (TR2) with high risk. The unrecommended TR2 category that is considered to be out of the scope of this thesis, May has a rule to change the results of malignancy although they are recommended as benign. On the other hand, FNAC has more sensitivity and specificity than ultrasonography in detecting cancer specially if done under guided ultrasonography, easy access and less harming and more safe. The pitfall of FNAC it cannot determine the histopathological subtypes of the thyroid cancer and cannot differentiate between follicular adenoma and carcinoma, as well has low accuracy if compared with final histopathology with sensitivity, specificity, PPV, NPV, and diagnostic accuracy as 93.69%, 72.50%, 86.30%, and 86.25%, respectively.

CONCLUSIONS

The resolution of ultrasonography machine has a great impact on validity (sensitivity, specificity) and evaluation of thyroid nodule. Ultrasound as being an operator dependent modality; experienced doctors add a lot for validity (sensitivity, specificity) as they show different outcomes.

For optimum diagnosis using ultrasonography in the evaluation of thyroid nodule the patients are needed to be categorized in groups according to ATA guidelines for risk stratification.

The final ultrasonography reports should follow the features of each TIRADS pattern, according to ATA.

The cytopathological results (FNAC report) will add an effect if it follows TBS.

A prospective study is more accurate than retrospective study in terms of excluding criteria throughout the study.

Conflict of interest

All author declare that they have no conflict of interest.

Ethics approval and consent to participate

Ethics of research applied.

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