Accuracy of FNAC in Thyroid Nodules in Comparison with Surgical Specimen: Qena Oncology Center Experience

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ABSTRACT

Background: Thyroid diseases are very common. Preoperative thyroid FNAC is now routine for most of thyroid surgery.

Objective: We aimed to compare preoperative FNAC of thyroid enlargement with postoperative histopathology to obtain a consensus methodology as a straightforward technique for diagnosing and optimally managing thyroid disorders.

Patient and methods: A retrospective study that was conducted at Qena Oncology Center at Department of Surgery including all patients underwent thyroid surgery during the period from January 2021 to June 2022. All FNAC were obtained under sonography guiding. The data of age, gender, complaint, unilateral or bilateral, U/S TIRADS & nodularity, type of operation and the result of pathology of FNAC and post-operative specimens were retrieved.

Results: The study included 98 cases of thyroid nodules (TN) diagnosed clinically where 85 patients (86.7%) females and 13 patients (13.3%) males. The main complaint of these patients was neck swelling in 65 patients (66.33%). FNAC results of 98 cases were 17 cases (17.4%) were malignant thyroid tumor (all of them were papillary) and 81 cases (82.6%) were benign, hemorrhagic smears or suspicious lesions. After surgical excision, histopathology 73 cases (74.5%) were benign lesions and 25 cases (25.6%) were malignant thyroid lesions, 24 cases (24.6%) were papillary carcinoma variants and only one case (1%) follicular carcinoma. The sensitivity of FNAC in determining malignant thyroid disease in our study is 68%. Specificity was 100% as no cases were reported as false positive by FNAC for malignancy in our study. So, the accuracy of the FNAC in TN for detecting cancer was 91.8% and the positive and negative predictive values were 100% and 90.1%, respectively.

Conclusion: Our study's findings are consistent with the data already available in publications, showing that FNA cytology is a sensitive, specific, and accurate first diagnostic test.

Keywords: FNAC, Thyroid nodules.

INTRODUCTION

After diabetes mellitus, thyroid gland disorders rank as the second most prevalent endocrine disorders[1]. TN are extremely frequent illnesses, with a percentage ranging from 4 to 10% in the adult population, and 5% to 30% of them are malignant [2].

FNAC is a well-established method for preoperative evaluation of thyroid nodule today. It is a simple, economical test for the diagnosis of malignancy, and its usage has significantly reduced the incidence of needless thyroid operations. When assessing TN, it is regarded as the gold standard diagnostic test [3].

When weighing the benefits of preoperative FNAC of thyroid swelling against postoperative histopathology, FNAC is becoming an increasingly important tool for helping with preoperative decision-making regarding thyroid swelling and for reaching consensus protocols as a straightforward process for diagnosis and optimal management of thyroid diseases [4]. The frequency of accidentally detected nodules has grown over the past several decades due to a considerable increase in imaging utilisation, with this picture being used to guide FNAC [5].

Thyroid FNAC specimens are now reported using the Bethesda system of reporting thyroid cytology (TBSRTC). **Cabs and Ali** [1] stated that this method was created in 2007 and is divided into the following six categories: (1) Insufficient or non-identifiable, (2) Non-cancerous and benign, (3) Atypical or unidentified follicular lesion, (4) Follicular neoplasm or suspicious for follicular neoplasm, (5) Suspicious for, but not diagnostic of, malignancy and (6) Malignant. Bethesda facilitates more accurate thyroid nodule research and diagnosis and enhances the interpretation of FNAC data [1].

However, FNAC is unable to distinguish between benign and malignant follicular neoplasms. Only after a thyroid lobectomy can follicular adenoma and follicular cancer be distinguished from one another [2, 3].

Numerous FNAC investigations revealed that a significant overlap existed between benign and malignant neoplasms, with around 68% of patients identified by FNAC as follicular neoplasms turning out to be the follicular form of papillary carcinoma [6].

Several worldwide scientific associations have developed clinico-radiological recommendations for the detection and treatment of TN [2, 7]. Sonographic features that favour a malignant nodule hat include hypoechoic solid nodule, solitary nodule, heterogeneity, absence of halo, absence of elasticity, presence of microcalcifications: almost always warrants biopsy, local invasion of surrounding structures, taller than wider, large size: the cutoff is often taken as 10 mm to warrant biopsy, suspicious

neck lymph nodes indicating metastatic disease, and/or intra-nodular blood flow (central vascularization).

European Thyroid Association Guidelines now is the standard for classification of the EU-TIRADS (Thyroid Imaging Reporting & Data System (TI-RADS™)) that is used to stratify the risk of malignancy in adult TN by ultrasound [8, 9].

Objective:

We aimed to compare preoperative FNAC of thyroid enlargement with postoperative histopathology to obtain a consensus methodology as a straightforward technique for diagnosing and optimally managing thyroid disorders.

PATIENT AND METHODS

Data collected through patients underwent thyroid surgery during the period from January 2021 to June 2022 about 18 months In Qena Oncology Center at surgery department. All FNAC were obtained under sonographic guide. The following information were retrieved age, gender, complaint, unilateral or bilateral, U/S TIRADS & nodularity, type of operation and the result of pathology of FNAC and post-operative.

Patient with solitary or multiple nodules were included in our study with normal thyroid function test.

FNAC was performed for all patients before preparation for surgery and histopathology results was obtained, unsatisfactory FNAC were excluded from our study.

All patients underwent complete history taking, lab investigation. Thyroid function tests FT3, FT4 & TSH. VC (vocal cords) examination. Anesthesia checkup. The specificity and sensitivity of cytological diagnoses were assessed using histological diagnosis. Cytological assessment findings were classed as positive or negative based on the outcomes of cytological and post-operative histopathological exams. The sensitivity, specificity, positive and negative predictive values, and accuracy were determined.

Ethical approval

The Ethics Committee of Qena Oncology Center granted the study approval. All participants signed informed consents after a thorough explanation of the goals of the study. The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

We looked over the captured data with SPSS, version 20.0. Relative percentages and frequencies were used to display the qualitative data. The mean ± SD and ranges were employed to show the quantitative data for parametric (normal) variables. They performed X^2-test analysis and Fisher's exact test. Through cross tabulation, PPV, NPV, and accuracy were determined once sensitivity and specificity were identified from the curve.

RESULTS

This study comprised 98 TN patients that have been clinically identified. There were 85 (86.7%) women and 13 (13.3%) men. The patients' ages varied from 16 to 67 years, with an average of 42.67 years. Neck edoema was the most common symptom among these patients, accounting for 65 instances (66.33%). All cases underwent surgical excision; 66 cases (67.4%) total thyroidectomy, 15 cases (15.3 %) total thyroidectomy and lymph node dissection, 15 cases (15.3%) hemi thyroidectomy either right or left according to pathology, 2 cases (2 %) underwent hemi thyroidectomy then completion thyroidectomy and LN dissection (Figure 1).
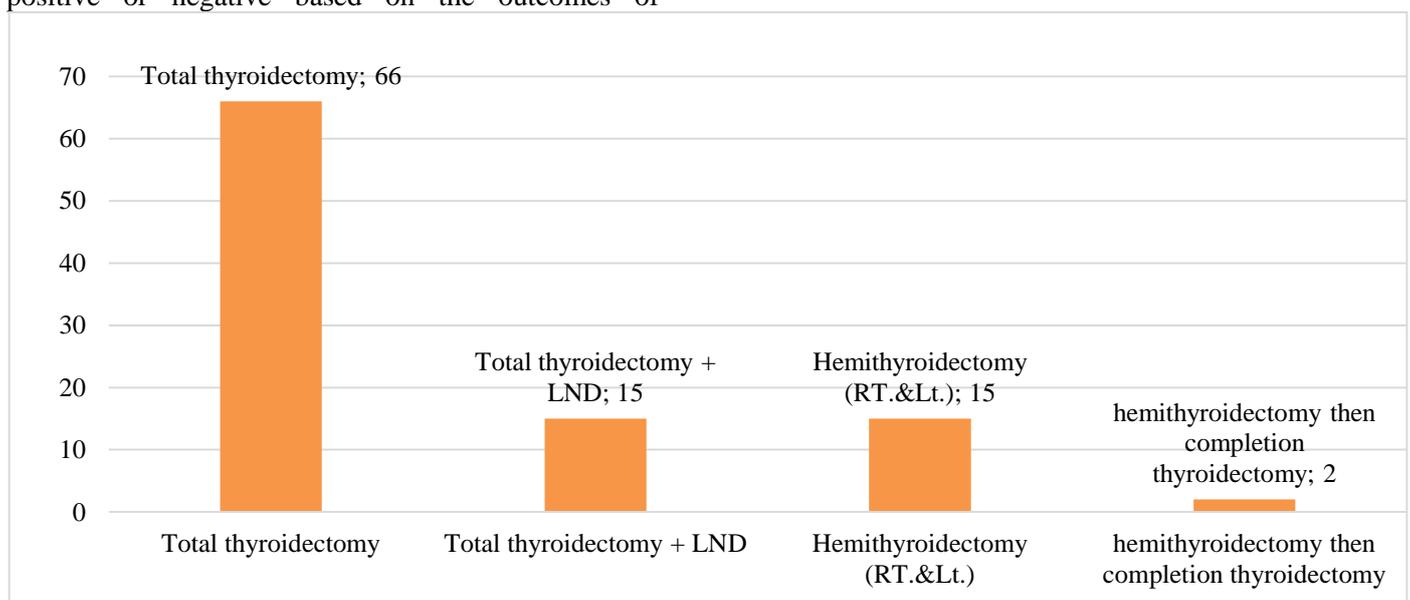

Figure (1): Types of operation.

FNAC results between 98 cases, there were 17 (17.4%) cases malignant thyroid (all of them were papillary) and 81 cases (82.6%) were benign, hemorrhagic smears or suspicious lesions. Between the 81 nonmalignant FNAC cases 27 cases (27.6%) were colloid nodules, 1 case (1%) was colloid nodule with Hashimoto thyroiditis, 2 cases (2%) were Hashimoto thyroiditis, 3 cases (3%) were Atypia of undetermined significance, 34 cases (34.7%) were follicular neoplasm, 8 cases (8.2%) were highly suspicious follicular neoplasm, 2 cases (2%) were Hurthle cell neoplasm, and 4 cases (4%) were hemorrhagic smears. After surgical excision histopathology, 73 cases (74.5%) were benign lesions (simple nodular goiter, colloid hyperplasia, adenomatous hyperplasia, follicular adenoma and Hashimoto thyroiditis, or Hurthle cell adenoma) 25 cases (25.6%) were malignant thyroid lesions, 24 cases (24.6%) were papillary carcinoma variants (univocal, bifocal, multifocal, multicentric and micropapillary, or follicular variant) and only one case (1%) was follicular carcinoma (Figure 2).
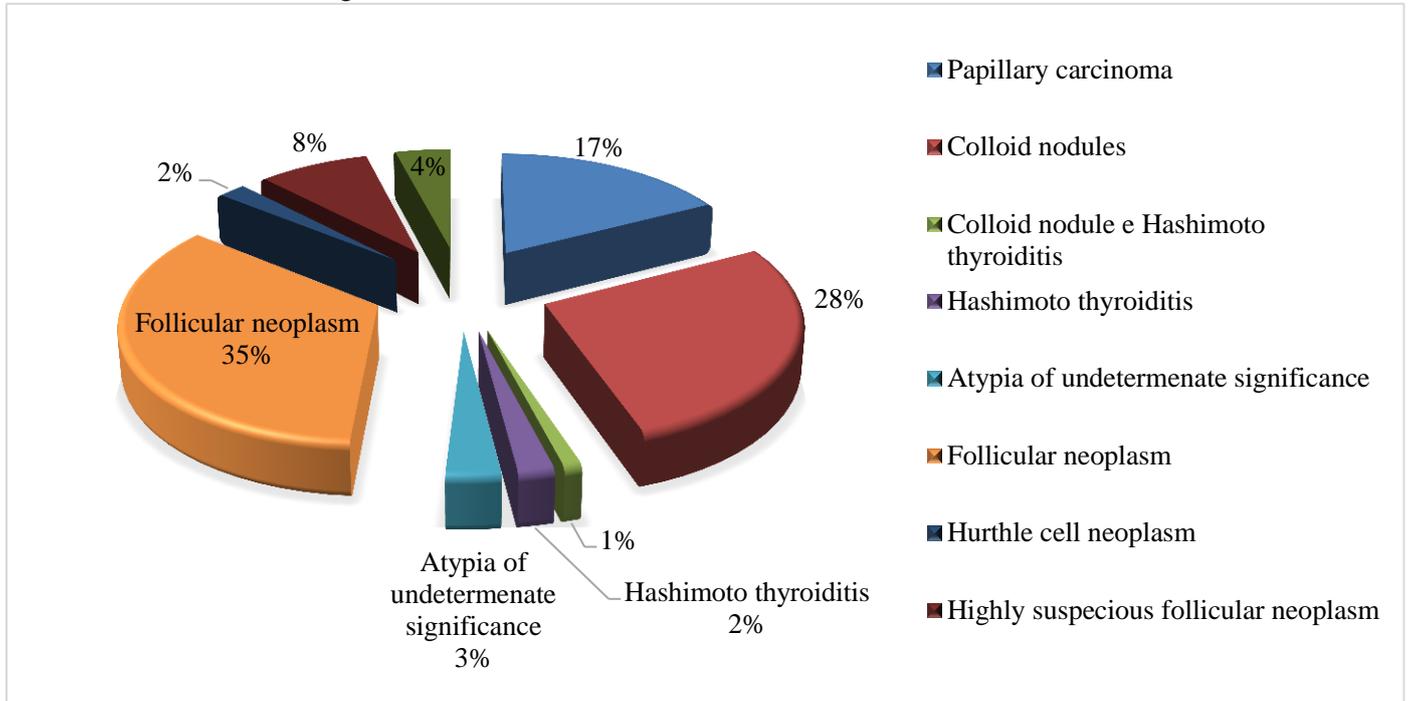

Figure (2): Types of pathology.

Sensitivity (True positive rate) = TP/TP+FN, Specificity (True negative rate) = TN/TN+FP
Positive predictive value (PPV) = TP/TP+FP, Negative predictive value (NPV) =TN/TN+FN
Total accuracy = TP+TN/ Total number of cases.

The sensitivity of FNAC in determining malignant thyroid disease in our study was 68%, specificity in our study was 100% as no cases were reported as false positive by FNAC for malignancy in our study. The accuracy of the FNAC in TN for detecting cancer is 91.8%, the positive and negative predictive values were 100% and 90.1%, respectively. The 8 false negative cases were diagnosed by FNAC as 3 cases suspicious follicular lesion, 2 cases hemorrhagic smears, 2 case follicular neoplasm and 1 case colloid nodule (Table 1).

Table (1): The sensitivity, Specificity, and accuracy of FNAC in malignant thyroid disease

	Sensitivity (True positive rate)	Specificity (True negative rate)	Positive predictive value (PPV)	Negative predictive value (NPV)	Total accuracy
	TP/TP+FN	TN/TN+FP	TP/TP+FP	TN/TN+FN	TP+TN/ Total number of cases
	17/25	73/73	17/17	73/81	90/98
	68%	100%	100%	90.1%	91.8%

DISCUSSION

Age and gender were connected with thyroid lesions. As described in previous studies, the male to female ratio of TN is around 1:4-5 [10, 11], and according to our study male to female ratio is 1:6.5 while the mean age in other studies is ranging from 40-52 years [12, 13], while in our study the mean age was 42.67 years .

Published data suggest unsatisfactory specimen (BETHEDA I) range between 2% and 20% [12, 14]. In our study the unsatisfactory specimens were 4 cases, which were not added to the study as exclusion criteria, but they account about 4%.

FNAC sensitivity and specificity in published series vary from 65% to 98% for sensitivity and 73-100% for specificity [15, 16], which is consistent with our study's sensitivity of 68% and specificity of 100%. The primary cause of the large variation in sensitivity and specificity ratios is the different ways in which lesions are classified; certain authors classify suspicious follicular lesions as histopathologically benign lesions, while other authors classify them as malignant [17].

Inadequate sampling, inexperience, and the inherent challenges of distinguishing benign from malignant follicular lesions can all impact the efficacy of FNAC. Additionally, the expected cellularity varies depending on the type of lesion. For instance, cystic nodules do not contain thyroid epithelial cells, nodules larger than 4 cm are too large to allow for adequate sampling from all areas, increasing the risk of misdiagnosis [17].

Our study's overall cytologic diagnostic accuracy of 91.8% is in line with the existing data that approaches 95% in terms of distinguishing benign from malignant thyroid gland nodules [18].

FNAC has drawbacks as well, such as the potential for false positive and false negative findings, particularly in cases of tiny tumours and when there is a concomitant inflammatory or degenerative change in the thyroid tissue nearby. Certain tumours may also have traits of both malignancy and benignity. Hence that it might not be able to distinguish between a follicular neoplasm and a cellular colloid goitre [19]. The number of patients who have surgery and a histologic evaluation after receiving a false-negative cytologic diagnosis determines how frequently this occurs [20].

Results from nine series including over nine thousand patients were reported by **Caruso and Mazzaferri** [21]. 74% of the cases were benign, 4% were malignant, 11% were inadequate, and 11% were worrisome. The range of false-negative rates is typically 1.5% to 11.5%. False negative results in our study 8.2%

Numerous studies concur that the false-negative incidence is less than 5% if all patients have thyroid surgery. Reject rates are reduced at facilities with skilled cytopathologists. A false-positive diagnosis occurs when benign lesions are discovered on histologic investigation in a patient who had a malignant FNAC result. The range of false positive rates is 0% to 8% (average: 3%) [16, 18, 19], and this meets our study in which false positive result is 0%.

It has been demonstrated that FNAC has comparable or even greater levels of sensitivity and accuracy than frozen section examination, making it the gold standard for the initial research into thyroid swelling diagnosis [22].

CONCLUSION

Our study's findings are consistent with the data already available in publications showing that FNA cytology is sensitive, specific, and accurate first diagnostic test. We recommend that trying to reach optimum result by the radiologist aspirate thyroid cytology with the pathologist at the same sitting. Also, we recommend to put in our mind that FNAC result (false negative) can be affected by radiologist and pathologist experience so the careful history taking (e.g. rapid growth) criteria of malignancy of TN in imaging (hypoechoic, irregular, micro calcifications and taller than wider) which will require repeat FNAC and/or surgery.

REFERENCES

1. **Cibas E, Ali S** (**2009**): NCI Thyroid FNA State of the Science Conference. The Bethesda system for reporting thyroid cytopathology. Am J Clin Pathol., 132: 658–65.
2. **Pandey P, Dixit A, Mahajan N (2012):** Fine-needle aspiration of the thyroid: A cytohistologic correlation with critical evaluation of discordant cases. Thyroid Res Pract., 9: 32–9.
3. **Yang J, Schnadig V, Logrono R** *et al.* **(2007):** Fine-needle aspiration of thyroid nodules: A study of 4703 patients with histologic and clinical correlations. Cancer, 111: 306–15.
4. **Sclabas G, Staerkel G, Shapiro S** *et al.* (**2003**): Fine-needle aspiration of the thyroid and correlation with histopathology in a contemporary series of 240 patients. Am J Surg., 186 (6): 702–710.
5. **Garg S, Mohan H, Nagarkar N** *et al.* (**2008**): Role of fine needle aspiration cytology in diagnosis and management of thyroid lesions: a study on 434 patients. J Cytol., 25 (1): 13-17.
6. **Weidekamma C, Schuellera G, Kaererc K** *et al.* (**2010**): Diagnostic value of sonography, ultrasound-guided fine-needle aspiration cytology, and diffusion-weighted MRI in the characterization of cold thyroid nodules. Eur J Radiol., 73: 538–544.
7. **Coorough N, Hudak K, Buehler D** *et al.* (**2011**): Fine needle aspiration of the thyroid: a contemporary experience of 3981 cases. J Surg Res., 170: 48–51.

8. **Agha R, Sohrabi C, Mathew G** *et al.* (**2020):** The PROCESS **2020** guideline: updating consensus preferred reporting of Case series in surgery (PROCESS) guidelines. Int J Surg., 84 (1): 231–235.

9. **Russ G, Bonnema S, Erdogan M** *et al.* (**2017):** European Thyroid Association Guidelines for Ultrasound Malignancy Risk Stratification of Thyroid Nodules in Adults: The EU-TIRADS. Eur Thyroid J., 6 (5): 225-237.

10. **Dauksiene D, Petkeviciene J, Klumbiene J** *et al.* (**2017):** Factors Associated with the Prevalence of Thyroid Nodules and Goiter in Middle-Aged Euthyroid Subjects. Int J Endocrinol., 17: 8401518. doi: 10.1155/2017/8401518

11. **Wong C, Wheeler M (2000):** Thyroid nodules: rational management. World J Surg., 24 (8): 934–41.

12. **El-Gammal A, E-Balshy M, Zahran K (2019):** Relationship between thyroid nodule size and incidence of thyroid cancer. Menoufia Med J., 32: 1142-8.

13. **Ramadan A, Kammash S, Haidi A** *et al.* **(2021):** Evaluation of the Incidence of Thyroid Cancer among Patients with Thyroid Nodules Attending to Suez Canal University Hospital. Suez Canal University Med J., 24 (2): 109-117.

14. **Bchir A, Bdioui A, Zammel H** *et al.* **(2021):** The importance of using fine-needle aspiration cytology in the diagnosis of thyroid nodules. Annals of Medicine and Surgery, 63: 102153. doi: 10.1016/j.amsu.2021.01.101

15. **Pandey P, Dixit A, Mahajan N (2012):** Fine-needle aspiration of the thyroid: A cytohistologic correlation with critical evaluation of discordant cases. Thyroid Res Pract., 9: 32-9.

16. **Bagga P, Mahajan N (2010):** Fine needle aspiration cytology of thyroid swellings: how useful and accurate is it? Indian J Cancer, 47: 437-442.

17. **Chandio A, Shaikh Z, Chandio K** *et al.* **(2018):** Accuracy of FNAC in diagnosis of thyroid gland diseases. Nurs and Palliat Care, 3 (1): 1-4.

18. **Mundasad B, Mcallister I, Carson J** *et al.* (**2006):** Accuracy of fine needle aspiration cytology in diagnosis of thyroid swellings. Internet J Endocrinol., 2: 20-25.

19. **Sinna E, Ezzat N (2012):** Diagnostic accuracy of fine needle aspiration cytology in thyroid lesions. Journal of the Egyptian National Cancer Institute, 24: 63–70.

20. **Kumar S, Aqil S, Dahar A (2008)**: Role of fine needle aspiration cytology in thyroid diseases. J Surg Pak., 13: 22-25.

21. **Caruso D, Mazzaferri E (1991):** Fine needle aspiration biopsy in the management of thyroid nodules. Endocrinologist, 1: 194-202.

22. **Orell S, Sterrett G, Whitaker D** *et al.* **(2005):** Thyroid. In: Fine needle aspiration cytology. 4th ed. Philadelphia: Churchill Livingstone, Pp: 126–164. https://research-repository.uwa.edu.au/en/publications/a-manual-and-atlas-of-fine-needle-aspiration-cytology.