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Diagnostic Value of FNAC in Solitary Thyroid Nodules: A Histopathological Correlation Study in Tertiary Care Center in Iraq

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ABSTRACT

Background: Thyroid nodules are a common clinical finding, usually encountered incidentally, 7–15% of them are cancerous. It is not clear how diagnostic accuracy of FNAC has changed since it became a critical part of thyroid nodule evaluation four decades ago.

Aim of study: To assess the diagnostic value of FNAC in solitary thyroid lesions in a sample of Iraqi patients.

Patients and Methods: A prospective study which was conducted at the surgical consultation clinic at Al-Yarmouk Teaching Hospital in Baghdad for a period of one year from February 2025 to February 2026. It included 100 patients who were diagnosed by clinical examination as a single thyroid nodule. All patients were evaluated thoroughly by taking history and clinical examination of the neck and other systems. Patients were sent for FNAC on their first visit with other investigations. Surgery was done for all patients under general anesthesia using collar incision. Patients were discharged and followed up till the results of histopathology were available.

Result: In this study, 88% of samples showed benign lesions by FNAC and 12% were malignant. By histopathology, 7% of samples were malignant lesions. The sensitivity of FNAC was 85.7%, while the specificity was 97.8%. PPV was 75%, NPV was 98.9%, and accuracy was 96.9%.

Conclusion: FNAC is a practical, cost-effective, and first-line diagnostic tool for single thyroid nodules, which can lead to better surgical decisions and better use of resources in clinical practice.

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INTRODUCTION

Nodules in the thyroid gland are a typical clinical manifestation; they are radiographically distinct from the surrounding parenchyma of the thyroid. [(1)]. When a clinical evaluation reveals what seems to be a single lesion in an otherwise healthy thyroid gland, this is known as a solitary thyroid nodule [(2)]. In patients without other symptoms of thyroid illness, the prevalence of nodules bigger than 1 cm is 50% according to autopsy data, making it a prevalent phenomenon. There is a 4-7% prevalence of nodules that can be felt [(3)]. Follicle nodules, which make up the bulk of nodular lesions, can be benign and present alone or as a cluster of nodules in a goiter. It is warranted to employ proper diagnostic methods in cases where there is a suspicion of carcinoma, as 7-15% of thyroid nodules are malignant [(4)]. Evaluating thyroid nodule is a process that begins with history and performing the physical examination, thyroid

scan, thyroid U/S, and fine needle aspiration cytology (FNAC) [5]. Over the last 20 years, there has been a shift in how thyroid nodules are clinically evaluated. Methods used nowadays have an emphasis on risk categorization through the use of selected cytology and ultrasonographic features [6]. For the evaluation of thyroid nodules, the gold standard, most dependable, and economically viable diagnostic is a thyroid FNAC biopsy. It has been used for diagnosing thyroid nodules for a long time in clinical practice. The diagnostic criteria provide clarity regarding post-FNAB therapy options and follow-up. The incidence of thyroid cancer is directly proportional to the number of thyroid nodule diagnoses [7]. Nodules larger than 1 cm exhibiting worrisome ultrasound characteristics should be considered for biopsy, according to the American Thyroid Association (ATA) [8]. The major approach for differentiating benign from malignant nodules is FNAC, even though diagnostic tools have improved [9]. Since its crucial role in thyroid nodule evaluation four decades ago, the evolution of FNAC's diagnostic accuracy remains unclear. The inclusion criteria and definitions of sensitivity and specificity vary, which accounts for the heterogeneity in the estimated ranges of 72% to 97% for FNB sensitivity and 73% to 99% for specificity in recent systematic studies [10, 11]. There is cause for worry regarding the diagnostic reliability of FNAC, since recent studies have shown an increase in both the false-negative rate and the false-positive rate, particularly for big nodules. Delays in diagnosis and treatment may occur due to false-negative FNAC results [12]. Thyroid problems are common in Iraq [13], however and to our knowledge, there is a lack of strong local data on the diagnostic performance of FNAC for solitary thyroid nodule diagnosis. Therefore, research into this area is necessary. While FNAC is a great option for health systems with limited resources because of its low cost and minimally intrusive nature, its accuracy can be affected by characteristics specific to the community, illness patterns, and the level of technical skill involved. The sensitivity, specificity, and predictive values of FNAC must be validated in the Iraqi scenario due to potential geographical variation in the frequency and histologic profile of thyroid cancers, variations in U/S availability, and surgical practice. This kind of study has the potential to enhance early diagnosis and appropriate treatment by refining diagnostic algorithms, decreasing the number of needless thyroid surgeries, and making better use of healthcare resources. The objective of the study is to assess the diagnostic value of FNAC in solitary thyroid lesions in a sample of Iraqi patients.

PATIENTS AND METHODS

Study design and setting

This is a prospective study which was conducted at the surgical consultation clinic at Al-Yarmouk Teaching Hospital in Baghdad for a period of one year from February 2025 to February 2026.

Study patients

The study included 100 patients who were presented to the hospital complaining from a thyroid nodule in the anterior aspect of the neck which diagnosed by clinical examination as a single thyroid nodule. Patients with non-thyroidal neck masses, diffuse goiter, or multinodular goiter were excluded from this study.

Evaluation

All patients were evaluated thoroughly by taking history and clinical examination of the neck and other systems. Regarding history, the following data were collected:

- ✓ Age and gender
- ✓ U/S performed or not.
- ✓ Neck pain
- ✓ Pressure symptoms (Stridor, dyspnea, and dysphagia).
- ✓ Size of single nodule (cm).
- ✓ Increasing in size of thyroid nodule.
- ✓ History of radiation exposure.
- ✓ Past medical history.
- ✓ Family history of pheochromocytoma or hyperparathyroidism.

Physical examination was done for fixation to the surrounding structures and the presence of palpable lymph node. Thyroid function tests were performed, antithyroid antibodies, CBC, ESR, and serum calcium.

Imaging studies included:

- U/S: Showing whether the nodule is cystic, solid, or mixed.
- Radioiodine scan: Showing whether the nodule is cold, warm, or hot.
- CXR: To detect any metastasis to the lung.

Workup:

- o Patients were sent for FNAC on their first visit with other investigations. FNAC was done in the cytology department of Al-Yarmouk Teaching Hospital.
- o Skilled personnel conducted aspiration and cytological analysis.

- Aspirating needles (21-24 gauge) connected to syringes (5-10 cc) are placed perpendicularly into the anterior surface of the neck, and the nodule is secured using the fingers of the non-aspirating hand.
- After penetrating the nodule, the cellular material can be jarred loose by deliberately moving the needle vertically back and forth for 1-2 mm, followed by one or two full revolutions of the needle. The next step is to use the syringe to apply negative pressure and aspirate the substance.
- The procedure begins by withdrawing the needle, followed by detaching it and reattaching it with air in the syringe. The cellular contents within the needle are forced onto a slide, which is promptly smeared and fixed, once air is released. The gauze was placed over the puncture site to apply pressure while the slides were being processed. Due to the lack of ultrasound guidance, further aspirations were necessary in a few individuals to guarantee adequate cell count
- The patients observed for a few minutes to make sure there was no swelling, bleeding, or significant discomfort.
- The results were categorized as:
  - Benign (The aspirate showed normal thyroid epithelial cells with varying amounts of red blood cells or colloid).
  - Malignant (In which case the smears showed a high degree of cellularity along with size, shape, and nuclear structural variations. The type of cancer could also be revealed in some smears).
  - Suspicious (Malignancy was suspected in situations where the smears showed high cellularity with sheets of follicular cells that exhibited nuclear diversity).
  - Nondiagnostic (When cytological testing was not possible due to an inadequate aspirate).
- Good preoperative preparations and evaluation of general status were done for all admitted patients.
- Surgery was done for all patients under general anesthesia using collar incision.
- Thyroid was assessed intraoperatively for the presence of other nodules or any suspicious area.
- Lobectomy + isthmectomy, subtotal thyroidectomy, and total thyroidectomy were done according to FNAC results.
- Postoperatively, antibiotics were given, airway observation and hemodynamic evaluation were done.
- Patients were discharged and followed up till the results of histopathology were available.

Ethical considerations

For an ethically sound research project like this one, it's important to follow the guidelines provided by the Declaration of Helsinki. We got the green light from the ethics committee at Al-Yarmouk Teaching Hospital. A signed informed permission was obtained from each patient after they were apprised of the study's aims and methods. The use of identifying coding and the storage of data in a password-protected environment ensured data security.

Statistical analysis

I used IBM SPSS Statistics for Windows, Version 28.0 (IBM Corp., Armonk, NY, USA) to analyze the data. The mean plus or minus the standard deviation (SD) was used to represent continuous variables. The numerical and percentage forms of categorical variables were used for presentation.

RESULTS

In this study, the mean age was 36.22 ± 9.5 years (range: 19 – 66 years), with 83 (83%) females. This study showed that 41% of them were housewives and 39% were overweighed (Table 1).

Table 1: Patients' Characteristics (n= 100)

Patients' Characteristics	No. (n= 100)	Percentage (%)
Age (Year)		
< 30	51	51.0
30 – 49	37	37.0
≥ 50	12	12.0
Gender		
Male	17	17.0
Female	83	83.0
Occupation		
Employee	36	36.0
Housewife	41	41.0
Private work	23	23.0
BMI Level		
Normal	33	33.0
Overweight	39	39.0
Obese	28	28.0

As shown in table (2), all patients complained from cervical swelling, the most common site of involvement was the right lobe (64%), 89% of patients were in euthyroid status, 61% showed normal thyroid scanning results, U/S found that 81% of lesions were cystic in type, and 76% of patients underwent lobectomy + isthmectomy surgical intervention.

Table 2: Clinical Characteristics (n= 100)

Variable	No. (n= 100)	Percentage (%)
Presenting symptoms		
Cervical swelling	100	100.0
Dysphagia	12	12.0
Dyspnea	8	8.0
Palpable lymph nodes	3	3.0
Site of involvement		
Right lobe	64	64.0
Left lobe	30	30.0
Isthmus	6	6.0
Thyroid status		
Euthyroid	89	89.0
Hyperthyroidism	11	11.0
Thyroid scanning results		
Cold	23	23.0
Warm	9	9.0
Hot	7	7.0
Normal	61	61.0
U/S findings		
Cystic	81	81.0
Solid	19	19.0
Type of surgery		
Lobectomy + isthmectomy	76	76.0
Subtotal thyroidectomy	16	16.0
Total thyroidectomy	8	8.0

As shown in figures (1 and 2), 88% of samples showed benign lesions by FNAC and 12% were malignant. By histopathology, 7% of samples were malignant lesions.

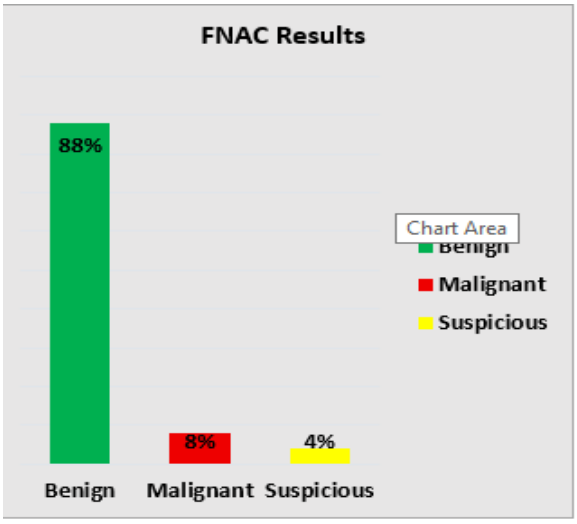

Figure 1: FNAC Results

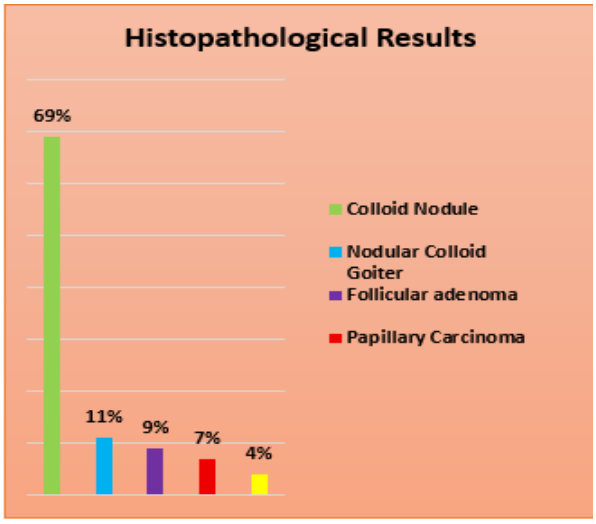

Figure 2: Histopathological Results

Table 3 shows the sensitivity, specificity, and accuracy of FNAC. The sensitivity was 85.7%, while the specificity was 97.8%. PPV was 75%, NPV was 98.9%, and accuracy was 96.9%.

Table 3: Sensitivity, specificity, and accuracy of FNAC

FNAC findings	Histopathology		
	Malignant lesion	Benign lesion	Total
Malignant	6	2	8
Benign	1	87	88
Total	7	89	96

DISCUSSION

The primary question raised in evaluating thyroid nodule is whether it's likely to require surgical treatment or not and what type of surgery is needed [2]. For solitary thyroid nodules in Iraq, this study offers much-needed local evidence about the diagnostic performance of FNAC. It contributes significantly to the preoperative investigations in patients with a solitary or dominant thyroid nodule but despite its well-recognized value, there are limitations to the technique [14]. This study showed that the sensitivity of FNAC in diagnosing malignant solitary thyroid nodule was 85.7%, while the specificity was 97.8%. PPV was 75%, NPV was 98.9%, and accuracy was 96.9%. These results were similar to results obtained in studies conducted by Bhise SV et al [15] and Kumar E et al [16] indicates that this test is highly reliable, particularly for ruling out disease. Although a small percentage of malignancies may potentially go unnoticed, the sensitivity of 85.7% indicates that most real tumors were accurately recognized. This highlights the importance of meticulous clinical and radiological correlation in worrisome cases with benign cytology. With a specificity of 97.8% and an NPV of 98.9%, FNAC clearly excels at identifying benign nodules. When FNAC detects a benign lesion, the chances of an underlying malignancy are incredibly low, allowing for the safe reduction of needless diagnostic surgeries along with the risks, expenses, and emotional and mental strain that come with them.

This study showed that the most common age of occurrence was thirties and forties (middle aged) with a females predominancy (83%), and the highest proportion were overweighed (39%). These findings are comparable to those found in studies conducted by Moradi L et al [17], Nadhum SJ et al [18], and Naz S et al [19]. Some theories put the greater illness load in this age group attributable to hormonal shifts, higher metabolic demands, and the increased prevalence of autoimmune diseases [20]. Numerous biological and hormonal variables account for the well-documented female predominance of thyroid nodules. Nodular alterations in the thyroid gland are more common in women because of the function that female sex hormones, especially estrogen, are believed to play in thyroid cell development and proliferation [21]. Structure abnormalities and nodule formation can be exacerbated by autoimmune thyroid illnesses, which disproportionately affect females (Hashimoto thyroiditis, for example) [22]. Furthermore, nodularity may be exacerbated by the fact that the thyroid is subjected to repetitive functional stress during physiological situations that are specific to women, such as pregnancy and the postpartum period [23]. A higher detection rate of thyroid nodules in females compared to males can be attributed to various factors, including genetic and immunological variations between the sexes, women's stronger health-seeking behavior, and their more frequent utilization of healthcare facilities [24].

STUDY LIMITATIONS

This study has several limitations that should be considered.

- ✓ The generalizability of the findings to other regions of Iraq or different levels of healthcare is limited as it was conducted in a single tertiary teaching hospital in Baghdad with a relatively small sample.
- ✓ This study is projected to selection bias as only clinically solitary nodules that proceeded to surgery were included excluding the many thyroid nodules that are managed conservatively or occur in multinodular goiter.
- ✓ Sample adequacy of FNAC may be affected as it was performed without ultrasound guidance.

CONCLUSION

FNAC is a practical, cost-effective, and first-line diagnostic tool for single thyroid nodules, which can lead to better surgical decisions and better use of resources in clinical practice. Through a comprehensive evaluation of one hundred patients at a prominent Baghdad tertiary center, our results are in line with international standards and reflect the reality of clinical practice in Iraq. Improved prioritization of patients with a high risk of cancer for prompt surgical intervention, less healthcare expenses, and fewer needless thyroid operations can all result from FNAC's increased use. To make the results more applicable to real-life situations and increase their generalizability, future research should rely on bigger, multicenter trials that incorporate both single and multiple nodular goiters.

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