

Assessing Diagnostic Concordance: A Retrospective Review of Preoperative Ultrasound and FNAC Against Final Histopathology

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ABSTRACT

Background-

Accurate preoperative diagnosis of thyroid nodules is essential to guide appropriate management and avoid unnecessary surgery. Ultrasound (USG) and fine-needle aspiration cytology (FNAC) are widely used diagnostic tools; however, their concordance with histopathology varies.

Aim:

To evaluate the diagnostic concordance and sensitivity of USG and FNAC compared with final histopathology in thyroid malignancies.

Methods:

This retrospective study included 15 patients with thyroid swelling who underwent USG, FNAC, and subsequent thyroid surgery between November 2022 and September 2024. Preoperative findings were compared with histopathological examination (HPE). Sensitivity and positive predictive value (PPV) were calculated.

Results:

All 15 cases were histopathologically confirmed malignancies. USG detected 6 true positives and 9 false negatives (sensitivity: 40%, PPV: 100%). FNAC detected 9 true positives and 6 false negatives (sensitivity: 60%, PPV: 100%). Papillary carcinoma was the most common malignancy (73.3%), followed by follicular (13.3%) and medullary carcinoma (13.3%).

Conclusion:

FNAC demonstrated higher sensitivity than USG, but neither modality alone was sufficient for detecting all malignant cases. A combined diagnostic approach improves accuracy and clinical decision-making.

Keywords: *Thyroid nodules, FNAC, Ultrasound, Histopathology, Diagnostic accuracy*

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1. INTRODUCTION

The thyroid gland plays a crucial role in regulating metabolism, growth, and development by secreting hormones such as thyroxine (T4) and triiodothyronine (T3). Located in the anterior part of the neck, the thyroid is susceptible to a variety of benign and malignant conditions, with thyroid nodules being among the most common clinical findings. While most thyroid nodules are benign, a small but significant proportion harbor malignancy, making early and accurate diagnosis essential for determining appropriate management strategies. Thyroid cancer accounts for approximately

Thyroid nodules are common in clinical practice, with a prevalence of up to 68% in the general population when detected by ultrasound (1). Although most nodules are benign, approximately 5–15% are malignant, necessitating accurate diagnostic evaluation (2).

Thyroid cancer accounts for 1–2% of all malignancies worldwide, with papillary thyroid carcinoma being the most common subtype (3). The incidence has been increasing due to improved detection methods (4).

Ultrasound (USG) is the first-line imaging modality and helps in risk stratification based on features such as hypo-echogenicity, irregular margins, microcalcifications, and taller-than-wide shape (2). The ACR TI-RADS classification system improves diagnostic consistency and risk prediction (2).

Fine-needle aspiration cytology (FNAC) remains the gold standard for preoperative evaluation and is categorized using the Bethesda System (3). However, FNAC has limitations, especially in follicular lesions where capsular invasion cannot be assessed cytologically (3).

Histopathology is the definitive diagnostic modality. Discordance between USG, FNAC, and histopathology may result in misdiagnosis and inappropriate management (5). Hence, evaluating diagnostic concordance is essential.

2% of all malignancies, with its incidence rising over the past few decades. The major subtypes of thyroid malignancies include papillary thyroid carcinoma (PTC), follicular thyroid carcinoma (FTC), medullary thyroid carcinoma (MTC), and anaplastic thyroid carcinoma (ATC), with PTC being the most common and least aggressive. Given the wide spectrum of thyroid nodule presentations and the varied risk of malignancy, precise diagnostic techniques are vital for guiding clinical decisions.

In the diagnostic work-up of thyroid nodules, preoperative assessment primarily relies on two key tools: high-resolution ultrasound and fine-needle aspiration cytology (FNAC). Ultrasound is a non-invasive imaging modality that provides valuable information regarding the size, echotexture, margins, and internal characteristics of thyroid nodules. Features such as hypo-echogenicity, irregular margins, microcalcifications, and increased vascularity are often associated with malignancy, aiding in risk stratification. Meanwhile, FNAC is a minimally invasive procedure that samples cellular material from the thyroid nodule for cytological evaluation. FNAC is widely regarded as the gold standard for preoperative thyroid nodule evaluation due to its ability to differentiate between benign and malignant lesions, reducing the need for unnecessary surgeries in benign cases. However, despite its effectiveness, FNAC can sometimes yield inconclusive or indeterminate results, particularly in cases of follicular lesions or other cytologically ambiguous nodules.

The challenge lies in achieving diagnostic concordance between these preoperative tools (ultrasound and FNAC) and the final histopathological findings, which are obtained following surgical excision of the thyroid nodule. Histopathology remains the definitive method for diagnosing thyroid malignancies, providing detailed insights into the architecture and cellular features of the nodule that preoperative tools cannot fully capture. Discrepancies between preoperative evaluations and histopathology can lead to under- or over-treatment, highlighting the importance of understanding the limitations and accuracy of these diagnostic modalities. This retrospective study seeks to assess the diagnostic concordance between preoperative ultrasound and FNAC findings with the final histopathological diagnosis in patients who underwent thyroid surgery. By evaluating the correlation between imaging, cytology, and histopathological outcomes, this study aims to provide insights into the diagnostic accuracy of these preoperative modalities. Additionally, the study will explore the factors that may contribute to discrepancies between preoperative and final diagnoses, particularly in the context of thyroid malignancies. Such findings are crucial for improving preoperative diagnostic protocols, refining clinical decision-making, and ultimately enhancing patient outcomes in thyroid nodule management.

2. METHODOLOGY

This retrospective study was conducted to assess the diagnostic concordance between preoperative ultrasound (USG) and fine-needle aspiration cytology (FNAC) findings against the final histopathological diagnosis in patients presenting with thyroid swelling. A cohort of 15 patients, who underwent thyroid surgery following preoperative evaluation, was included in the study. All patients presented with clinical complaints of thyroid swelling and were subjected to preoperative

diagnostic investigations, including USG and FNAC.

Study Design:

Retrospective observational study.

Study Setting:

Single tertiary care center.

Study Duration:

November 2022 to September 2024.

Sample Size:

15 patients.

Inclusion Criteria:

- Patients with thyroid swelling
- Underwent both USG and FNAC
- Preoperative suspicion of malignancy
- Available histopathology reports

Exclusion Criteria:

- Incomplete records
- No FNAC or USG
- Benign lesions not operated

Data Collection

- Demographics: Age, gender
- USG features:
 - Hypo-echogenicity
 - Microcalcifications
 - Irregular margins
 - Taller-than-wide shape
- FNAC results: Bethesda classification or categorized as benign/malignant
- Histopathology: Gold standard

Patient data were collected retrospectively from medical records, including demographic details (age, gender), clinical presentation, and the results of preoperative USG and FNAC. The ultrasound results were reviewed for specific characteristics suggestive of malignancy, including nodule size, echogenicity, margins, the presence of calcifications, and vascularity. FNAC reports were categorized based on the Bethesda System for Reporting Thyroid Cytopathology (if used) or classified as benign, malignant, suspicious for malignancy, or non-diagnostic.

All patients underwent thyroid surgery, and their final histopathological reports were obtained and analyzed. Histopathological examination provided the definitive diagnosis of the thyroid nodule, distinguishing between benign and malignant lesions and specifying the type of malignancy when present.

Diagnostic Concordance Assessment

The primary objective of the study was to evaluate the concordance between the preoperative findings (USG and FNAC) and the final histopathological diagnosis. For each patient, USG and FNAC results were compared with the histopathological findings to determine the diagnostic accuracy of the preoperative modalities. Concordance was defined as agreement between USG/FNAC findings and the final histopathological diagnosis in identifying malignant nodules.

The following diagnostic measures were assessed:

- True positives: Cases where both USG/FNAC and histopathology indicated malignancy.
- False positives: Cases where USG/FNAC suggested malignancy, but histopathology revealed benign findings.
- False negatives: Cases where USG/FNAC failed to identify malignancy, but histopathology confirmed malignancy.
- True negatives: Cases where both USG/FNAC and histopathology indicated benign findings (though not expected in this study as all patients had preoperative suspicion of malignancy).

Statistical Analysis

Descriptive statistics were used to summarize the patient demographics and the distribution of USG, FNAC, and histopathology findings. Concordance rates between USG, FNAC, and histopathology were calculated to determine the overall diagnostic accuracy of these preoperative modalities. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of USG and FNAC were also calculated to further evaluate their diagnostic performance.

3. RESULT

USG data

True positives – 6 (patients who were positive on USG and had malignancy confirmed by HPE). False negatives – 9 (patients who were negative on USG but had malignancy confirmed by HPE). False Positive and True Negative are not applicable since all patients had confirmed malignancy

FNAC Data

True Positives – 9 (patients who were on FNAC and had malignancy confirmed by HPE). False Negatives- 6 (patients who were negative on FNAC but had malignancy on HPE). False Positive and True Negative are not applicable since all patients had confirmed malignancy

USG

Sensitivity – $(9/(9+6)) \times 100 = 40\%$

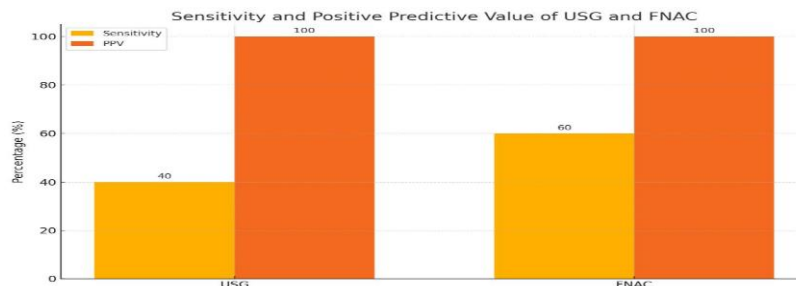
PPV = $(6/(6+0)) \times 100 = 100\%$

FNAC

Sensitivity – $(9/(9+6)) \times 100 = 60\%$

PPV- $(9/(9+0)) \times 100 = 100\%$

| TEST | TRUE POSITIVES | FALSE NEGATIVES | SENSITIVITY | PPV |
|------|----------------|-----------------|-------------|------|
| USG | 6 | 9 | 40% | 100% |
| FNAC | 9 | 6 | 60% | 100% |



| USG FINDINGS | PRESENT | ABSENT |
|--------------------|---------|--------|
| TALLER THAN WIDER | 5 | 1 |
| HYPOECHOGENICITY | 3 | 3 |
| MICROCALCIFICATONS | 3 | 3 |
| IRREGULAR MARGINS | 4 | 2 |

| | POSITIVE USG RESULTS | POSITIVE FNAC RESULTS | HPE RESULTS |
|----------------------|----------------------|-----------------------|-------------|
| PAPILLARY CARCINOMA | 4 | 7 | 11 |
| FOLLICULAR CARCINOMA | 1 | 1 | 2 |
| MEDULLARY CARCINOMA | 1 | 1 | 2 |

All 15 cases were histopathologically confirmed malignancies. USG detected 6 true positives and 9 false negatives (sensitivity: 40%, PPV: 100%). FNAC detected 9 true positives and 6 false negatives (sensitivity: 60%, PPV: 100%). Papillary carcinoma was the most common malignancy (73.3%), followed by follicular (13.3%) and medullary carcinoma (13.3%). None of the cases came out to be anaplastic

4. DISCUSSION

In this study, FNAC demonstrated higher sensitivity (60%) compared to USG (40%), consistent with previous literature (1,5).

Brito et al. reported that ultrasound alone has limited specificity and should not be used as a standalone diagnostic tool (1). Similarly, Tessler et al. emphasized the importance of combining ultrasound with cytological evaluation (2).

FNAC has been widely validated as a reliable diagnostic tool, with reported sensitivity ranging from 65–98% (3). The lower sensitivity observed in this study may be attributed to the small sample size and inclusion of only malignant cases. The predominance of papillary carcinoma (73.3%) aligns with global epidemiological trends (4).

A major limitation of this study is the absence of benign cases, which prevented calculation of specificity and NPV. Additionally, the retrospective design and small sample size limit generalizability.

Recent advances such as molecular testing (e.g., BRAF mutation) have shown promise in improving diagnostic accuracy in indeterminate cases (5).

5. CONCLUSION

The findings from this study emphasize the importance of a multimodal approach in the preoperative assessment of thyroid nodules.

Neither USG nor FNAC alone was able to detect all malignant cases, suggesting that reliance on a single diagnostic tool could lead to missed diagnoses.

The combined use of both imaging and cytology increases the likelihood of accurately identifying malignant nodules.

In cases where FNAC results are indeterminate or USG findings are suspicious but not definitive, clinicians may need to consider additional diagnostic tools such as molecular testing or proceed with surgical excision for a conclusive diagnosis.

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