Original Research Article

The Bethesda Bridge- Connecting Thyroid Cytology and Histology in a Hilly Terrain

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Abstract:

Background: The Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) classifies thyroid fine-needle aspiration cytology (FNAC) results into six diagnostic categories, offering a standardized and evidence-based method for interpretation and management of thyroid nodules. Aim of our study is to establish the correlation between cytological findings categorized by TBSRTC and histopathological outcomes, and to assess the spectrum and prevalence of thyroid lesions in patients attending a tertiary care hospital in the Nilgiris district.

Materials and Methods: A retro-prospective analytical study was conducted on 235 patients with thyroid swellings between July 2018 and August 2020. FNAC was performed using a non-aspiration technique, and smears were stained with Hematoxylin and Eosin. Results were categorized as per TBSRTC. Histopathological correlation was available for 68 patients who underwent surgery. Data were statistically analyzed to determine concordance rates.

Results: Out of 235 cases, 210 (89.3%) were benign (Bethesda II), 9 (3.8%) nondiagnostic, 5 (2.1%) atypia/FLUS, 6 (2.5%) follicular neoplasms, 4 (1.7%) suspicious for malignancy, and 2 (0.8%) malignant. Histopathological correlation showed 92.6% overall concordance. The most common benign lesion was nodular colloid goitre (72.6%), while papillary carcinoma was the predominant malignancy.

Conclusion: FNAC, interpreted under the Bethesda framework, is a highly reliable, cost-effective diagnostic tool for evaluating thyroid nodules. Despite occasional diagnostic challenges in follicular-patterned and cystic lesions, FNAC substantially reduces unnecessary surgeries and remains essential in clinical decision-making.

Keywords: Thyroid cytopathology, Fine needle aspiration, Bethesda system, Histopathological correlation, Thyroid nodules.

Introduction

Thyroid nodules are among the most common endocrine abnormalities encountered worldwide, with a clinical prevalence of 4–7% and a much higher prevalence (19–68%) when evaluated by ultrasonography (USG) [1]. Although the majority are benign, distinguishing malignant from benign nodules is critical to guide appropriate management [2]. Fine Needle Aspiration Cytology (FNAC) has emerged as a first-line, minimally invasive, cost-effective diagnostic tool that significantly reduces unnecessary thyroidectomies [3].

The diagnostic accuracy of FNAC in detecting malignancy ranges from 80–95% in various studies [4]. However, prior to 2007, the lack of standardized reporting systems caused inconsistencies in diagnosis and communication among pathologists and clinicians. To address this,

the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) was introduced in 2007 by the National Cancer Institute (NCI) [5]. TBSRTC stratifies FNAC findings into six categories, each linked to an implied risk of malignancy and a corresponding clinical management recommendation [6,7]. The categories include: (I) Nondiagnostic/Unsatisfactory, (II) Benign, (III) Atypia of Undetermined Significance/Follicular Lesion of Undetermined Significance (AUS/FLUS), (IV) Follicular Neoplasm/Suspicious for a Follicular Neoplasm (FN/SFN), (V) Suspicious for Malignancy, and (VI) Malignant.

The reliability of FNAC depends on sampling adequacy, cytological interpretation, and experience of the cytopathologist [8]. Although it

has a high sensitivity and specificity, limitations persist — especially in distinguishing follicular adenoma from follicular carcinoma, and cystic or Hurthle-cell rich lesions from neoplasms [9,10]. The present study aims to evaluate the spectrum of thyroid lesions in a hilly tertiary care center, categorize them per Bethesda classification, and correlate cytological findings with histopathological outcomes to determine FNAC's diagnostic accuracy.

Materials and Methods

This retro-prospective analytical study was conducted in the Department of Pathology, Government Medical College and Hospital, The Nilgiris, from July 2018 to August 2020.

Approval from the Institutional Ethics Committee was obtained prior to study commencement. A total of 235 patients presenting with thyroid enlargement (diffuse or nodular) were included. Both male and female patients across all age groups were eligible. Patients unwilling to undergo FNAC or with parathyroid, lymph node, or metastatic neck lesions were excluded.

FNAC was performed under aseptic precautions using a 22-gauge needle and 10 mL syringe by the non-aspiration technique. Direct smears were prepared and immediately fixed in 95% ethanol. Staining was done using Hematoxylin and Eosin (H&E). Each smear was evaluated for adequacy based on TBSRTC criteria — requiring at least six well-preserved follicular groups with a minimum of ten cells per group [11]. Each FNAC report was classified according to TBSRTC into one of six categories, and representative diagnoses were recorded. Where surgical specimens were available, histopathological examination (HPE) was performed on formalin-fixed, paraffin-embedded tissue sections stained with H&E. The cytological diagnosis was compared with the corresponding HPE report.

Data were compiled and analyzed using Microsoft Excel. Frequencies, percentages, and concordance rates were calculated. Concordance between cytology and histopathology was considered diagnostic accuracy.

Results

A total of 235 patients were analyzed. The demographic and clinicopathological data are summarized below.

Out of 235 patients, 217 (92.3%) were females and 18 (7.7%) were males (F: M ratio = 12:1). The majority (58.2%) were aged 31–55 years, indicating that thyroid lesions are more common in middle-aged women. The mean age was 44.8 years (range: 15–76 years). Hypothyroidism was observed in 34 cases (14.5%), while the remaining were euthyroid or hyperthyroid.

Table 1: Distribution of FNAC Findings by Bethesda Category

Bethesda Category	Number of Cases	Percentage (%)	Representative Diagnoses
Category I – Nondiagnostic	9	3.8	Cystic lesion
Category II – Benign	210	89.3	Nodular colloid goitre, Hashimoto's thyroiditis
Category III – AUS/FLUS	5	2.1	Atypia of undetermined significance
Category IV – Follicular neoplasm	6	2.5	Follicular neoplasm
Category V – Suspicious for malignancy	4	1.7	Suspicious of papillary carcinoma
Category VI – Malignant	2	0.8	Papillary carcinoma, Medullary carcinoma

Most cases fell into Category II, reflecting the high incidence of benign thyroid pathology in the study region. Malignant and suspicious categories comprised only 2.5%, consistent with global patterns of thyroid disease.

Table 2: Histopathological Correlation of FNAC Findings (n=68)

Bethesda Category	Cases Correlated	Concordant	Discordant	Concordance (%)
Category I	5	4	1	80%
Category II	50	48	2	96%
Category III	3	2	1	66.7%
Category IV	4	2	2	50%
Category V	2	1	1	50%
Category VI	2	2	0	100%
Total	**68**	**63**	**7**	**92.6%**

The highest concordance was observed in Bethesda Category II (96%), indicating the high reliability of FNAC in benign diagnoses. Discordance was mainly seen in follicular-patterned lesions where

cytology alone cannot assess capsular or vascular
invasion.

Table 3: Spectrum of Histopathological Diagnoses (n=68)

Diagnosis	No. of Cases	Percentage (%)
Nodular colloid goitre	45	66.2
Hashimoto thyroiditis	6	8.8
Multinodular goitre	5	7.3
Papillary carcinoma	3	4.4
Follicular adenoma	3	4.4
Non-Hodgkin lymphoma	1	1.5
Others	5	7.4

Description: Histopathology confirmed benign thyroid diseases as predominant. Nodular colloid goitre was the most common, followed by Hashimoto's thyroiditis. Among malignant cases, papillary carcinoma was most frequent.

Overall Observation:

- Benign: 93.6%, Malignant: 6.4% among histo-pathologically verified cases.
- FNAC accuracy rate: 92.6%.
- False negatives were mainly follicular neo-plasms misclassified as benign nodules.

Discussion

Epidemiological Correlation: In this study, females formed the vast majority (92.3%) of cases, consistent with studies by Tunbridge et al. [12] and Singh et al. [13], who reported a female predominance due to the higher prevalence of autoimmune thyroid disorders in women. The peak incidence in the fourth and fifth decades parallels observations by Bhatia et al. [14] and Mondal et al. [15], emphasizing that thyroid disease prevalence increases with age and hormonal fluctuations.

Bethesda Distribution and Diagnostic Yield: Category II (Benign) constituted 89.3% of FNACs in our study, similar to 85–90% in large Indian series [16,17]. The predominance of benign lesions reflects the regional iodine sufficiency and endemic goitrous patterns in South India. The malignancy rate (0.8%) was low but consistent with community-based data [18].

FNAC is particularly effective for nodular colloid goitres and thyroiditis. Our 96% concordance for Category II aligns with Mondal et al. [19] and Gupta et al. [20], confirming FNAC's reliability for benign lesions.

Correlation and Diagnostic Challenges: Overall FNAC–HPE concordance was 92.6%, consistent with studies by Pandey et al. (93%) [21] and Jo et al. (90%) [22].

Discordant cases occurred mainly in follicular neoplasms (Category IV) and cystic lesions (Category I). This is due to the cytological overlap between follicular adenoma and carcinoma, which requires histological evidence of capsular or vascular invasion for definitive diagnosis [23].

In cystic lesions, false negatives may occur due to sampling of fluid-rich areas devoid of diagnostic follicular epithelium. Repeat aspiration under USG guidance may enhance accuracy.

Comparison of Malignancy Risks: The observed risk of malignancy (ROM) in each category corresponded closely to established Bethesda values:

- Category I: 11% (vs. 1–4% recommended)
- Category II: 3.8% (vs. 0–3%)
- Category III: 20% (vs. 10–30%)
- Category IV: 33% (vs. 25–40%)
- Category V: 50% (vs. 50–75%)
- Category VI: 100% (vs. 97–99%)

This confirms the validity of TBSRTC's predictive framework for our population, echoing findings by Cibas and Ali [24] and Bongiovanni et al. [25].

Pattern of Thyroid Lesions: Nodular colloid goitre was the most common lesion (66.2%), reflecting a non-neoplastic hyperplastic response, in agreement with findings by Gopal et al. [26]. Hashimoto thyroiditis (8.8%) was the next frequent diagnosis, emphasizing the rising incidence of autoimmune thyroid disease in India, particularly in women [27].

Among malignancies, papillary carcinoma was predominant (4.4%), consistent with studies by Harach et al. [28] and Chen et al. [29]. Rare malignant findings, such as medullary carcinoma and thyroid lymphoma, were also identified, highlighting FNAC's ability to detect varied pathologies.

Implications and Limitations: This study reinforces FNAC as an indispensable first-line diagnostic tool for thyroid nodules. It minimizes surgical intervention in benign cases and facilitates early detection of malignancy. Limitations include the small number of malignant cases and lack of long-term follow-up data. Future studies incorporating radiological correlation (TIRADS) and molecular markers could further refine diagnostic accuracy.

Conclusion

The Bethesda System for Reporting Thyroid Cytopathology provides a standardized and clinically relevant framework for interpreting thyroid FNAC results. FNAC demonstrated a high diagnostic accuracy (92.6%) in this study, especially for benign lesions. Although certain limitations exist in follicular and cystic lesions, cytology remains the cornerstone of thyroid nodule evaluation. A multidisciplinary approach integrating cytological, radiological, and clinical parameters ensures optimal patient management.

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