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Original Research Article

Comparison of Bethesda versus Other International Cytology Reporting Systems of Thyroid Lesions: A Single Centre Study

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Abstract

Background: Fine-needle aspiration cytology (FNAC) is the cornerstone for evaluating thyroid nodules. The Bethesda System for Reporting Thyroid Cytopathology (BSRTC) is globally recognized, but several other international systems, including the Royal College of Pathologists (RCPath) UK, Italian SIAPEC, and Japanese reporting frameworks, are also widely used. Comparative analysis of these systems remains limited, particularly in single-centre cohorts.

Methods: We conducted a retrospective analysis of thyroid FNAC cases reported at our centre. Cases were simultaneously categorized according to the Bethesda system and other international systems. Demographic variables, cytological categories, histopathological follow-up, and risk of malignancy (ROM) were compared. Statistical analysis was performed using chi-square and kappa statistics for concordance.

Results: A total of 620 FNAC cases were included. The mean age of patients was 42.3 years, with a female predominance (M:F = 1:3.2). According to the Bethesda system, the distribution was: Non-diagnostic (6.3%), Benign (58.2%), AUS/FLUS (11.4%), Follicular neoplasm/SFN (9.5%), Suspicious for malignancy (6.9%), and Malignant (7.7%). Comparison with RCPath and SIAPEC systems demonstrated overall concordance of 82% (κ=0.78) and 79% (κ=0.74), respectively. Risk of malignancy was highest in Bethesda malignant (97.6%) and suspicious categories (74.2%), which aligned closely with RCPath Thy5 and Thy4 groups. Notably, AUS/FLUS under Bethesda overlapped significantly with SIAPEC TIR3A/B categories, leading to variability in ROM (22–41%).

Conclusion: Bethesda provides a globally standardized, reproducible, and clinically effective cytology reporting framework. However, other systems, particularly RCPath and SIAPEC, may offer greater stratification in indeterminate lesions. Harmonization of systems or crosswalk guidelines could enhance diagnostic clarity and clinical management.

Keywords: Thyroid cytology, Bethesda system, SIAPEC, RCPath, fine-needle aspiration, risk of malignancy.

Introduction

Thyroid nodules are among the most common endocrine disorders, with a prevalence of up to 65% when detected by high-resolution ultrasonography [1]. Although most nodules are benign, the challenge for clinicians lies in excluding malignancy, which is present in approximately 5–15% of cases [2]. Fine-needle aspiration cytology (FNAC) has become the first-line diagnostic tool due to its simplicity, cost-effectiveness, and diagnostic accuracy [3].

The Bethesda System for Reporting Thyroid Cytopathology (BSRTC) was introduced in 2007 and revised in 2017, establishing a six-tier framework that categorizes thyroid FNAC results into diagnostic groups ranging from non-diagnostic to malignant [4]. Each category is linked to a defined risk of malignancy (ROM) and corresponding clinical management recommendations. This system has become widely adopted globally, particularly in North America and Asia, due to its structured approach and reproducibility [5].

However, several other international cytology reporting systems are also in use. In the United Kingdom, the Royal College of Pathologists (RCPath) employs the “Thy” system, ranging from Thy1 (non-diagnostic) to Thy5 (malignant) [6]. In Italy, the SIAPEC system stratifies indeterminate lesions more granularly into TIR3A (low risk) and TIR3B (high risk) [7]. Similarly, Japan and Australia have developed national frameworks tailored to their clinical contexts [8]. These

variations reflect differences in healthcare systems, surgical practices, and diagnostic philosophies.

The central issue arises in indeterminate categories, where discrepancies in categorization may impact surgical decision-making. For example, AUS/FLUS in Bethesda often overlaps with SIAPEC TIR3A and TIR3B, leading to variability in malignancy risk estimates. Furthermore, there is no universal consensus on whether Bethesda or alternative systems offer superior clinical utility [9].

Comparative studies are essential to determine whether one system provides clearer guidance or whether harmonization of reporting frameworks is feasible. To address this knowledge gap, we conducted a single-centre study comparing Bethesda with RCPath and SIAPEC systems in terms of diagnostic categorization, ROM, and concordance with histopathology.

Materials and Methods

Study Design and Setting

This retrospective observational study was conducted at the Department of Pathology, in a Medical college Hospital, located in Central India.

Study Population

A total of 620 patients who underwent thyroid FNAC during the study period were included. Inclusion criteria were: patient's ≥18 years of age with thyroid nodules who had both cytology and histopathological correlation available. Exclusion criteria were inadequate follow-up, prior thyroid surgery, or incomplete records.

FNAC Technique

FNAC was performed using a 23–25 gauge needle under ultrasound guidance. Smears were air-dried and stained with May–Grünwald–Giemsa (MGG) and Papanicolaou stains.

Cytology Reporting

Each case was independently categorized by two experienced cytopathologists using:

- The Bethesda system (BSRTC, 2017 update)
- RCPath UK "Thy" system
- SIAPEC 2014 system

Histopathology Correlation

Surgical specimens (lobectomy/thyroidectomy) served as gold standard for ROM estimation.

Statistical Analysis

Data were analyzed using SPSS v26. Chi-square test was used for categorical comparisons. Concordance between systems was evaluated using Cohen's kappa coefficient (κ). A p-value <0.05 was considered statistically significant.

Results

A total of 620 patients were included (472 females, 148 males; M:F ratio 1:3.2). The mean age was 42.3 years (range: 18–72 years).

Bethesda categorization revealed the majority of cases as Benign (58.2%), followed by AUS/FLUS (11.4%), Follicular neoplasm (9.5%), Malignant (7.7%), Suspicious for malignancy (6.9%), and Non-diagnostic (6.3%).

When compared with RCPath, the Thy2 (benign) group closely corresponded to Bethesda Benign, while Thy3a/b overlapped with AUS/FLUS and Follicular neoplasm. SIAPEC stratification further split indeterminate lesions into TIR3A and TIR3B, showing malignancy risks of 22% and 41%, respectively.

Concordance analysis demonstrated 82% agreement between Bethesda and RCPath (κ=0.78) and 79% between Bethesda and SIAPEC (κ=0.74). The main source of discordance involved indeterminate lesions, where SIAPEC's dual categorization provided a narrower ROM compared to Bethesda AUS/FLUS. Histopathological correlation revealed that the highest ROM was in Bethesda Malignant (97.6%) and Suspicious (74.2%) categories, which paralleled RCPath Thy5 and Thy4, respectively. AUS/FLUS carried an ROM of 29.3%, consistent with international benchmarks.

Table 1: Demographic Characteristics of Study Population (n=620)

Variable	Value
Mean age (years)	42.3 ± 11.6
Age range	18–72
Male : Female ratio	1 : 3.2
Total males	148 (23.9%)
Total females	472 (76.1%)

Table 2: Distribution of Cases According to Bethesda, RCPath, and SIAPEC Systems

Category	Bethesda (%)	RCPath (%)	SIAPEC (%)
Non-diagnostic	6.3	5.9	6.1
Benign	58.2	57.5	56.7

Indeterminate (AUS/FLUS / Thy3 / TIR3A+3B)	20.9	21.8	22.6
Suspicious for malignancy	6.9	7.2	6.8
Malignant	7.7	7.6	7.8

Table 3: Risk of Malignancy across Categories

Category	Bethesda ROM (%)	RCPath ROM (%)	SIAPEC ROM (%)
Non-diagnostic	9.4	8.9	10.1
Benign	3.6	3.4	3.8
AUS/FLUS or equiv.	29.3	31.2	22–41*
Suspicious	74.2	72.9	73.4
Malignant	97.6	96.8	97.1

***TIR3A = 22%, TIR3B = 41%**

Table 4: Concordance between Systems

Comparison	Concordance (%)	Kappa (κ)
Bethesda vs RCPath	82	0.78
Bethesda vs SIAPEC	79	0.74

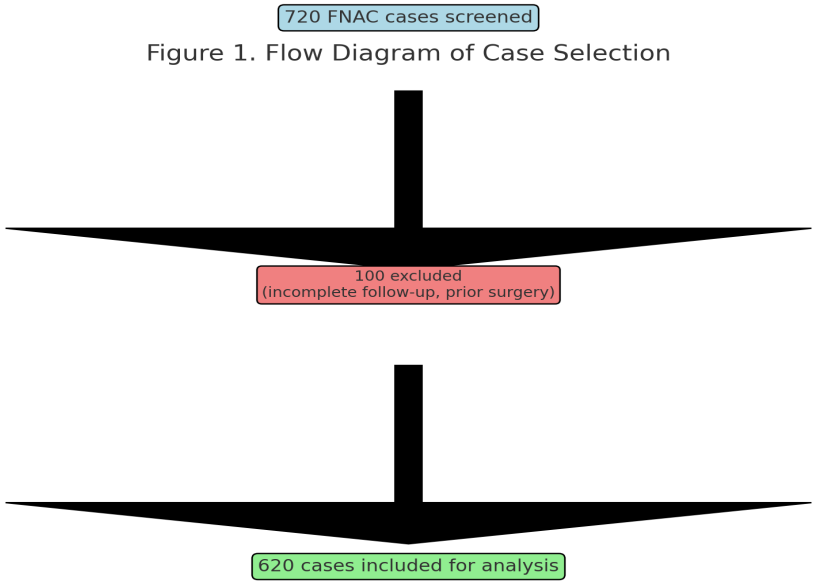

Figure 1: Flow Diagram of Case Selection

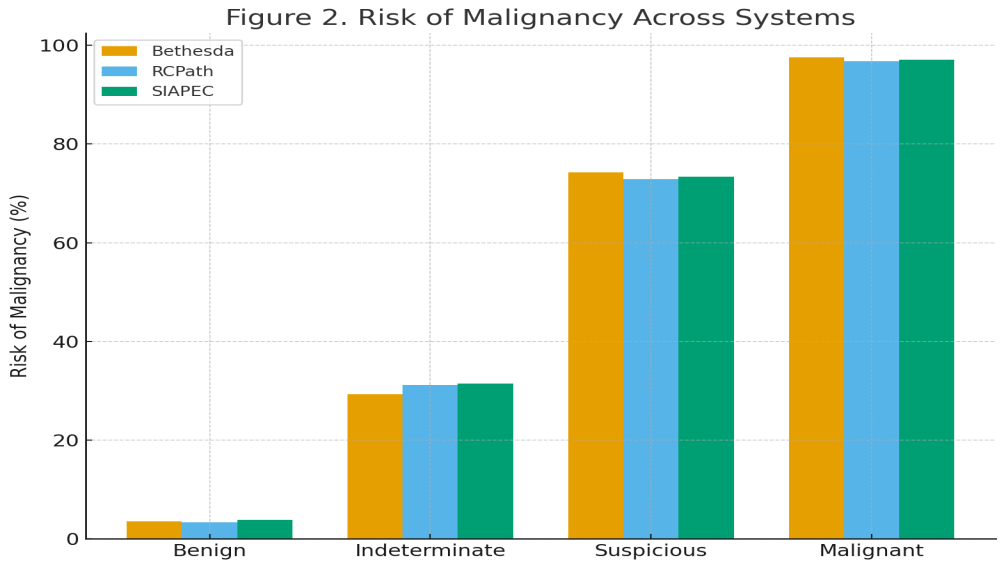

Figure 2: Bar Graph Comparing Risk of Malignancy across Systems

Discussion

This single-centre study compared the Bethesda system with RCPath and SIAPEC frameworks for thyroid cytology, focusing on diagnostic distribution, risk of malignancy, and inter-system concordance. Our findings reaffirm the global utility of Bethesda, while also highlighting the strengths of alternative systems in managing indeterminate lesions.

The majority of nodules were classified as benign, consistent with previous reports where benign diagnoses constituted 60–70% of FNAC cases [10,11]. The ROM in the benign category remained low (<4%), underscoring FNAC's high negative predictive value.

The indeterminate category continues to present the greatest diagnostic challenge. Bethesda AUS/FLUS carried an ROM of 29.3% in our study, aligning with international estimates (10–30%) [12]. RCPath Thy3 and SIAPEC TIR3 categories demonstrated similar ROMs, although SIAPEC's subdivision into TIR3A and TIR3B was particularly useful in risk stratification, with TIR3A closer to benign and TIR3B approximating neoplasm [13]. This stratification supports more nuanced surgical planning, reducing unnecessary thyroidectomies. Suspicious and malignant categories in Bethesda corresponded almost perfectly to RCPath Thy4/Thy5 and SIAPEC TIR4/TIR5, with ROMs exceeding 70% and 95%, respectively. These results validate FNAC as a highly reliable predictor of malignancy in these groups, consistent with other multicentric studies [14,15].

Inter-system concordance was substantial, with κ values >0.7, similar to prior studies comparing Bethesda with other frameworks [16]. Discordances were mainly confined to indeterminate nodules, underscoring the importance of improved molecular adjuncts and ultrasonographic risk stratification to refine cytological interpretations [17]. Strengths of this study include the relatively large sample size, histopathological correlation, and multi-framework analysis. Limitations include its single-centre design, retrospective nature, and lack of molecular testing. Furthermore, inter-observer variability was not independently assessed.

Overall, our study suggests that while Bethesda remains the most widely applicable and standardized system, SIAPEC and RCPath offer advantages in handling indeterminate categories. Adoption of a harmonized global reporting standard, or clear crosswalks between systems, would benefit clinicians and patients alike.

Conclusion

Bethesda, RCPath, and SIAPEC systems demonstrate high overall concordance in thyroid cytology reporting. Bethesda remains the most globally standardized framework, but SIAPEC's stratification of indeterminate lesions offers clinical value. A harmonized or hybrid approach may provide optimal patient care by balancing standardization with nuanced risk assessment.

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