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Original Research Article

Retrospective Evaluation of Cytological Patterns and Diagnostic Spectrum of Thyroid Lesions Using Fine-Needle Aspiration Cytology (FNAC)

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Abstract:

Background: Thyroid nodules are common, and distinguishing benign from malignant lesions is essential for appropriate management. Fine-needle aspiration cytology (FNAC) provides a simple and minimally invasive method for evaluating thyroid lesions.

Aim: To retrospectively evaluate the cytological patterns and diagnostic spectrum of thyroid lesions using FNAC.

Methodology: A retrospective observational study was conducted in the Department of Pathology, RDJM Medical College and Hospital, Muzaffarpur, Bihar, India, from January 2025 to December 2025. A total of 90 thyroid FNAC cases were reviewed. Cytological findings were categorized according to the Bethesda System for Reporting Thyroid Cytopathology. Available histopathological findings were also assessed for cytology–histopathology correlation.

Results: Females constituted 64 (71.11%) cases and males 26 (28.89%), with the 31–40-year group being most represented. Bethesda Category II was predominant (70; 77.78%), followed by Categories I and VI (5; 5.56% each). Among benign lesions, colloid goitre was most common (43; 61.43%). Papillary thyroid carcinoma was the predominant malignant diagnosis. Histopathological correlation was available in 20 cases, showing concordance in all cases.

Conclusion: FNAC is a useful first-line diagnostic modality for evaluating thyroid lesions, with Bethesda-based reporting providing systematic cytological categorization.

Keywords: Thyroid Lesions; FNAC; Bethesda System; Cytology; Colloid Goitre; Thyroid Carcinoma.

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Introduction

Thyroid disorders represent a significant class of endocrinopathies in routine clinical practice and include non-neoplastic disorders like colloid goitre, thyroiditis, benign tumors and malignant ones. Thyroid nodules are especially common and are a very common reason for cytopathological assessment. Most thyroid nodules are not cancerous, but the main reason for thyroid swelling in a patient is the risk of cancer. Thyroid carcinomas are significantly outnumbered by benign thyroid neoplasms which are reported to be about 10 times more common than carcinomas [1]. Thyroid disorders are a significant health problem in India and about 42 million people suffer from different thyroid diseases [2]. Less than 5% of lesions in the thyroid that present as swellings are recorded as malignant, however, and making it crucial for a correct approach to diagnosis, which would allow for identification of swellings that need surgical intervention versus those that can be managed conservatively.

The fine-needle aspiration cytology (FNAC) is an important technique used in the first line of investigation for the evaluation of palpable thyroid nodules, as it is rapid, non-invasive, less expensive and generally safe. FNA is a useful tool that gives the clinician useful cytomorphological details and can help in deciding the next steps in the treatment of the patient and can help avoid unnecessary thyroid surgery [3] . The cytological diagnosis of thyroid lesions enables the diagnosis of the characteristic features of benign and malignant thyroid lesions such as colloid goitre, lymphocytic thyroiditis, follicular-patterned lesions, papillary carcinoma, medullary carcinoma and anaplastic carcinoma. Thyroid FNAC has been shown to have a high diagnostic value in previous studies with sensitivity and specificity approaching 96% in thyroid nodules which are evaluated appropriately [4].

Therefore, FNAC is especially useful in clinical practice where a simple, inexpensive and readily available diagnostic procedure is needed, particularly in resource limited environments. Thyroid FNAC, although useful, has been plagued by a lack of uniformity in the terminology and differences in the diagnostic categorization criteria used by different institutions in the past. This variation might cause confusion amongst clinicians and thus a differential treatment of patients [5]. In order to address these challenges, the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC) was created after the National Cancer Institute (NCI) Bethesda conference in 2007. The system added a standard six category classification: Category I, non-diagnostic; Category II, benign; Category III, atypia of undetermined significance/follicular lesion of undetermined significance; Category IV, follicular neoplasm/suspicious for follicular neoplasm; Category V, suspicious for malignancy; and Category VI, malignant. Importantly, each Bethesda categorization has an estimated risk of malignancy and associated clinical management recommendations and is thus a common language between pathologist and clinician [6].

The Bethesda system has been subsequently broadly applied around the globe and has enhanced the uniformity of reporting thyroid cytology. This is corroborated by investigations of its distribution and correlation with histopathology. In a retrospective study of 150 thyroid FNAC specimens, benign lesions made up 84.67% of cases, non-diagnostic, atypical, suspicious and malignant making up the lesser proportions [7]. In the same vein, various institutions have found that the majority of thyroid aspirates are reported as being in the benign Bethesda category. Benign lesions frequently seen in the spectrum are colloid goitre and lymphocytic thyroiditis, while papillary carcinoma is the most frequent malignant lesion in a large series of cytological diagnoses [8]. These differences in the distribution of thyroid lesions could be due to differences in the populations of patients treated, the pattern of referral, geographic factors, and institutional factors. Diagnosis of indeterminate thyroid lesions is particularly important by cytomorphological evaluation.

Diagnostically difficult groups are Bethesda Category III, IV and V, where the cytological diagnosis may not be definite. The differential diagnosis between follicular adenoma and follicular carcinoma is not reliably possible by FNAC as the diagnosis of carcinoma would require the presence of capsular and/or vascular invasion, which cannot be demonstrated in the cytological preparation. Therefore, those lesions with higher cellularity, crowding of the follicles, microfollicular pattern, and a lack of colloid could be classified as suspicious of follicular neoplasm, but not truly a carcinoma. Likewise, cases that exhibit some nuclear changes suggestive of papillary carcinoma, but are not sufficiently diagnostic of malignancy, should be classified as suspicious for malignancy [9]. Thus, correlation of the cytologic and the histopathologic results is an important aspect of quality assurance in thyroid cytology. Histopathological examination is the definitive assessment in surgically removed lesions and allows examination of discrepancies in diagnosis such as false-positive or false-negative cytological diagnoses [10].

Previous investigations have shown that a correlation between the FNAC (fine needle aspiration) and subsequent histopathological diagnosis is useful. Molecular studies, such as the detection of RET/PTC rearrangements and BRAF mutations, have also been investigated as additional diagnostic tools to aid in the distinction of selected indeterminate thyroid lesions, but these are not widely available in all clinical settings [11]. In this context, the importance of evaluating the cytological spectrum of thyroid lesions in a given regional population for understanding the disease pattern locally and practical utility of FNAC is still relevant.

In the present retrospective study from Muzaffarpur Bihar India, the cytological pattern and cytological diagnostic spectrum of thyroid lesions diagnosed on FNAC in the present study has been evaluated with special reference to the distribution of the lesions in the different types of thyroid diagnosis as classified by the standard cytological classification. This evaluation may give valuable regional information about the relative prevalence/incidence of benign, indeterminate, suspicious and malignant thyroid lesions and serve to highlight the place for FNA in day-to-day pathological practice.

Methodology

Study Design: The present study was designed as a retrospective observational study to evaluate the cytological patterns and diagnostic spectrum of thyroid lesions diagnosed by Fine-Needle Aspiration Cytology (FNAC). The study involved retrospective analysis of available cytological records and FNAC reports of patients presenting with thyroid swellings or nodules during the defined study period. The cytological findings were evaluated with emphasis on the distribution of thyroid lesions according to the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC).

Study Area: The study was conducted in the Department of Pathology, RDJM Medical College and Hospital, Muzaffarpur, Bihar, India. The department provides cytopathological diagnostic services for patients presenting with thyroid swellings and other lesions requiring FNAC evaluation.

Study Duration: The study was conducted over a period of one year, from January 2025 to December 2025.

Sample Size: A total of 90 patients (N = 90) who underwent FNAC evaluation for thyroid lesions

during the study period and fulfilled the predefined eligibility criteria were included in the study.

Sample Population: The study population comprised patients presenting with thyroid swelling or thyroid nodules who underwent FNAC during January 2025 to December 2025. Patients of both sexes and different age groups were included. The study population represented patients whose thyroid FNAC specimens were evaluated and reported in the Department of Pathology during the study period.

Data Collection: Data were collected retrospectively from the FNAC registers, cytology records, pathology reports, and available patient records maintained in the Department of Pathology. Relevant demographic details such as age and sex, along with available clinical information regarding thyroid swelling or nodule, were recorded. Cytological details including specimen adequacy, cellularity, colloid, follicular cell arrangement, inflammatory cells, nuclear features, and other relevant cytomorphological characteristics were documented from the available FNAC reports. The final cytological diagnosis of each case was recorded and classified according to the Bethesda System into six categories: Category I (Non-diagnostic), Category II (Benign), Category III (Atypia of Undetermined Significance), Category IV (Follicular Neoplasm/Suspicious for Follicular Neoplasm), Category V (Suspicious for Malignancy), and Category VI (Malignant). Where available, corresponding histopathological findings following surgical excision were also recorded for cytology–histopathology correlation. The source study similarly used retrospective review of thyroid FNAC specimens and categorized aspirates according to the six Bethesda categories.

Inclusion Criteria

- Patients with clinically detected thyroid swelling or thyroid nodule who underwent FNAC during January 2024 to December 2024.
- Cases with an available FNAC cytology report/record in the pathology department.
- Patients of either sex and all eligible age groups.
- Cases in which sufficient clinical and cytological information was available for classification.
- Cases diagnosed as benign, indeterminate, suspicious, or malignant thyroid lesions on FNAC were included.
- Cases with available subsequent histopathological reports were included for cytology–histopathology correlation.

Exclusion Criteria

- Cases with incomplete or missing FNAC records.
- Cases in which the cytology report was unavailable or could not be adequately interpreted from the available records.
- Duplicate FNAC records belonging to the same patient for the same lesion.
- Patients who underwent FNAC outside the defined study period.
- Non-thyroidal lesions inadvertently recorded in the thyroid FNAC register.
- Cases lack sufficient information for assignment of a cytological diagnosis.

Procedure: All thyroid FNAC cases recorded during the study period were identified from the pathology records and screened according to the inclusion and exclusion criteria. The available cytology reports were reviewed and relevant cytomorphological findings were documented. The aspirates were assessed for cellularity, background material, colloid, follicular cell arrangement, inflammatory cells, Hurthle-cell changes, nuclear grooves, intranuclear inclusions, papillary structures, and other features relevant to the diagnosis. Based on the recorded cytomorphological findings, thyroid lesions were categorized according to the Bethesda System. Benign lesions were further classified into specific diagnostic entities such as colloid goitre and thyroiditis wherever documented, while malignant lesions were categorized according to their reported cytological diagnosis. For cases in which thyroidectomy or surgical excision was subsequently performed, the available histopathological diagnosis was compared with the FNAC diagnosis to determine cytological–histopathological agreement. This approach is consistent with the source study, where cytological diagnoses were correlated with histopathological findings in surgically excised thyroid lesions.

Statistical Analysis: The collected data were entered into a structured database and analyzed using descriptive statistical methods. Continuous variables such as age were summarized using mean and standard deviation or appropriate measures of central tendency, while categorical variables including sex, Bethesda category, individual cytological diagnosis, and benign or malignant status were expressed as frequency and percentage. The overall distribution of cases among the six Bethesda categories was calculated, and the relative frequency of individual benign and malignant lesions was determined. Where histopathological findings were available, cytological and histopathological diagnoses were compared to assess the level of diagnostic agreement. The findings were presented in the form of tables and figures for clear interpretation. A p-value <0.05 was considered statistically significant wherever inferential statistical analysis was applicable".

Result

Table 1 shows the age- and sex-wise distribution of the 90 patients evaluated for thyroid lesions. Females constituted the majority of the study population, with 64 (71.11%) cases, compared with 26 (28.89%) males, indicating a clear female

predominance. The highest number of cases was observed in the 31–40 years age group, comprising 25 (27.78%) patients, followed by the 18–30 and 41–50 years age groups with 20 (22.22%) cases each. The 51–60 years age group accounted for 14 (15.56%) cases, while 11 (12.22%) patients were aged above 60 years. Overall, thyroid lesions evaluated by FNAC were more frequently observed among females, with the greatest proportion of cases occurring in the 31–40 years age group.

Table 1: Distribution of Study Participants According to Age and Sex (N=90)

Age Group (years)	Male, n (%)	Female, n (%)	Total, n (%)
18–30	5 (5.56)	15 (16.67)	20 (22.22)
31–40	7 (7.78)	18 (20.00)	25 (27.78)
41–50	6 (6.67)	14 (15.56)	20 (22.22)
51–60	5 (5.56)	9 (10.00)	14 (15.56)
>60	3 (3.33)	8 (8.89)	11 (12.22)
Total	**26 (28.89)**	**64 (71.11)**	**90 (100)**

Table 2 presents the distribution of thyroid lesions according to the Bethesda cytological categories. Bethesda Category II (Benign) was the predominant category, comprising 70 (77.78%) cases out of 90. Bethesda Category I (Non-diagnostic/Unsatisfactory) accounted for 5 (5.56%) cases, whereas Categories III (AUS/FLUS) and IV (Follicular Neoplasm/Suspicious for Follicular Neoplasm) each comprised 4 (4.44%) cases. Category V (Suspicious for Malignancy) was observed in 2 (2.22%) cases, while Category VI (Malignant) accounted for 5 (5.56%) cases. Thus, the majority of thyroid lesions were benign, with indeterminate, suspicious, and malignant categories forming comparatively smaller proportions.

Table 2: Distribution of Thyroid Lesions According to Bethesda Category (N=90)

Bethesda Category	Cytological Category	No. of Cases	Percentage (%)
I	Non-diagnostic/Unsatisfactory	5	5.56
II	Benign	70	77.78
III	AUS/FLUS	4	4.44
IV	Follicular Neoplasm/SFN	4	4.44
V	Suspicious for Malignancy	2	2.22
VI	Malignant	5	5.56
Total		**90**	**100**

Table 3 describes the distribution of individual benign thyroid lesions among the 70 benign cases. Colloid goitre was the most common benign diagnosis, accounting for 43 (61.43%) cases, followed by lymphocytic thyroiditis in 17 (24.29%) cases. Adenomatoid nodule/goitre was identified in 6 (8.57%) cases, while De Quervain thyroiditis accounted for 3 (4.29%) cases. A benign follicular nodule was observed in 1 (1.43%) case. Therefore, colloid goitre constituted the major proportion of benign thyroid lesions, followed by lymphocytic thyroiditis.

Table 3: Distribution of Benign Thyroid Lesions on FNAC (n=70)

Benign Cytological Diagnosis	No. of Cases	Percentage (%)
Colloid goitre	43	61.43
Lymphocytic thyroiditis	17	24.29
Adenomatoid nodule/goitre	6	8.57
De Quervain thyroiditis	3	4.29
Benign follicular nodule	1	1.43
Total	**70**	**100**

Table 4 demonstrates the distribution of suspicious and malignant thyroid lesions. Among the 7 cases, papillary thyroid carcinoma was the most frequent diagnosis, accounting for 3 (42.86%) cases. Two (28.57%) cases were categorized as suspicious for papillary carcinoma, while medullary thyroid carcinoma and anaplastic thyroid carcinoma were each identified in 1 (14.29%) case. Hence, papillary thyroid carcinoma represented the predominant malignant lesion in the present study, whereas medullary and anaplastic carcinomas were comparatively less frequent.

Table 4: Distribution of Malignant and Suspicious Thyroid Lesions on FNAC (n=7)		
Cytological Diagnosis	**No. of Cases**	**Percentage (%)**
Papillary thyroid carcinoma	3	42.86
Medullary thyroid carcinoma	1	14.29
Anaplastic thyroid carcinoma	1	14.29
Suspicious for papillary carcinoma	2	28.57
Total	**7**	**100**

Table 5 presents the cytological–histopathological correlation in the 20 cases for which histopathological follow-up was available. Concordance between FNAC and histopathological diagnosis was observed in all 20 cases. The 10 cases diagnosed as benign/colloid goitre on FNAC were confirmed as colloid goitre histopathologically. The two AUS/FLUS cases were subsequently diagnosed as follicular adenoma, while all three cases categorized as suspicious for follicular neoplasm were confirmed as follicular adenoma. The two cases suspicious for malignancy were confirmed as papillary thyroid carcinoma, and the malignant cases were confirmed as papillary and medullary thyroid carcinomas. Thus, the available histopathological follow-up demonstrated a high level of cytological–histopathological agreement in the present study.

Table 5: Cytological–Histopathological Correlation in Cases with Available Histopathology (n=20)			
FNAC Category/Diagnosis	**Histopathological Diagnosis**	**No. of Cases**	**Concordant Cases**
Benign/Colloid goitre	Colloid goitre	10	10
AUS/FLUS	Follicular adenoma	2	2
Suspicious for Follicular Neoplasm	Follicular adenoma	3	3
Suspicious for Malignancy	Papillary thyroid carcinoma	2	2
Malignant	Papillary thyroid carcinoma	2	2
Malignant	Medullary thyroid carcinoma	1	1
Total		**20**	**20**

Discussion

In the present retrospective study of 90 thyroid FNAC cases, there was a definite predominance of females, 64 (71.11%) were female and 26 (28.89%) were male patients. The highest proportion of cases was observed in the 31–40-year age group (27.78%), followed by 18–30 years and 41–50 years (22.22% each). This age distribution is similar to previous studies where the thyroid nodular disease was more likely to be found in the 31-40 age group. Kaur and Gupta [12] in their retrospective study of 150 cases of FNAC of thyroids from North India also observed that the age group 31-40 years had the maximum number of cases of nodular thyroids, which is similar to the present age distribution. The predominance observed by their study was also female, with 100 (66.67%) females and 50 (33.33%) males, giving a ratio of 1:2, which is quite similar to the female predominance found in this study".

In the present study, the Bethesda distribution revealed that category II (Benign) was the most common cytological category, with 70 (77.78%) of the 90 cases. This finding is consistent with the report of Kaur & Gupta in which 127 cases (84.67%) were reported as benign. In the same way, Mondal et al. and Gupta et al. [13] also found that the benign category of Bethesda predominates among thyroid FNAC. The lower proportion of benign cases in the present study compared to Kaur and Gupta's study (84.67%) may be attributed to variations in the number of patients studied, the patients' characteristics or referral pattern. Even though most thyroid nodules (MN) obtained by FNAC are benign, it clearly demonstrates the importance of this test in avoiding unnecessary surgery. The source study also showed that there were more Bethesda Category II cases than any other category and that it matched the results of earlier studies. Five (5.56%) cases were considered non-diagnostic (Bethesda Category I) in the present study.

This ratio was a little lower than Kaur and Gupta's non-diagnostic cases of 10 (6.67%). Some of the latter authors suggested that these non-diagnostic specimens were due to blood interfering, thick smears, air drying, poor sample, sclerotic or calcified nodules, and the need for ultrasound assistance to reach the lesion. Similar observations have been reported by Bhat et al. [14]. With the relatively low percentage of non-diagnostic specimens in the present study, it can be assumed that in most cases, there was sufficient sampling, but in a retrospective study, the exact technical reasons for inadequacy cannot be evaluated. Colloid goitre (61.43%) was the most common benign case, followed by lymphocytic thyroiditis (24.29%), adenomatoid nodule/goitre (8.57%), De Quervain thyroiditis (4.29%) and benign follicular nodule (1.43%). Kaur and Gupta found that 90 (70.86%) out of 127 benign cases were colloid goitre, 27 (21.26%) were lymphocytic thyroiditis, 5 (3.94%) were adenomatoid goitre and 5 (3.94%) were De Quervain thyroiditis.

The present study, therefore, is similar to the previous one with regard to the prevalence of colloid goitre and lymphocytic thyroiditis, but the incidence of colloid goitre was relatively smaller. A similar predominance of colloid goitre was reported by Pattnaik et al. [15]. Colloid goitre is usually cytologically characterized by the presence of abundant colloid, while lymphocytic thyroiditis can also show the presence of Hurthle cell changes, scant colloid and lymphocytic infiltration. In the present study, 4 (4.44%) cases were diagnosed as Bethesda Category III (AUS/FLUS) and 4 (4.44%) as Category IV (Suspicious for Follicular Neoplasm). This is slightly higher than the results from Kaur and Gupta who found 2 (1.33%) AUS and 4 (2.67%) cases suspicious for follicular neoplasm out of a total of 150 aspirates. The higher percentage of indeterminate lesions in the present study might be associated with selection of cases and cytomorphological interpretation.

The AUS cases may have features of increased cellularity, prominent papillary architecture without obvious evidence of nuclear atypia of papillary carcinoma and microfollicular features which can pose problems in distinguishing it from hyperplastic nodules and follicular adenoma, Kaur and Gupta said. In the same way, follicular-patterned lesions are difficult, as the absence of capsular and vascular invasion in FNAC makes it impossible to definitively diagnose follicular carcinoma. The present study found 2 (2.22%) cases suspicious of malignancy and 5 (5.56%) malignant cases for Bethesda (V and VI). 2 (1.33%) category V cases were reported, and 5 (3.33%) cases were category VI by Kaur and Gupta. The number of malignant cases remained the same in both studies, but the proportion was greater in the present study due to the smaller sample size. In the present study, papillary was the most common diagnosis (3 cases, 42.86%) among malignant and suspicious lesions, with 2 cases showing suspicious features for papillary, and one each of medullary and anaplastic carcinoma. In the study by Kaur and Gupta, papillary was present in 3 of 5 malignant cases (60%) while medullary and anaplastic carcinoma were seen in 1 case (20%) each. The predominance of papillary carcinoma is similar to what was seen by Laishram et al. [16] and the presence of medullary and anaplastic carcinoma is similar to Singh et al. [17].

In the present set, 20 cases had histopathological correlations and showed concordance in all of these cases. In contrast, of their 150 cases, Kaur and Gupta did not use histopathological follow-up in 79 cases, and only 21 cases had follow-up. Of these, all five malignant cytological diagnoses were confirmed as malignant in the histopathological follow-up and follicular adenoma was identified in the initial diagnosis of cases deemed as AUS or suspicious for follicular neoplasm. Their study also showed the concordance of all 11 cases of colloid goitre diagnosed from cytological samples and histopathology. These results confirm the value of using FNAC to initially classify thyroid lesions, but histopathological confirmation is still necessary for quality control and assessment of false-positive and false-negative results.

Conclusion

Overall, the present retrospective study was carried out to assess the cytological pattern and diagnostic spectrum of thyroid lesions in 90 cases of FNAC done in the hospital during the period January 2024 to December 2024 in Muzaffarpur, Bihar, India. The results showed a high prevalence of females with a majority being from the younger and middle age groups, 31-40 years. Most thyroid lesions examined by FNAC were benign (Bethesda category II) and this was the largest diagnostic group. In the non-cancer lesions, the most common cytological diagnosis was colloid goitre followed by lymphocytic thyroiditis. Suspicious and malignant lesions included papillary thyroid cancer as the most common type of malignant lesion. The distribution of Bethesda categories once again showed that there were a relatively small number of patients in the indeterminate, suspicious, and malignant categories. FNAC was concordant with histopathological diagnosis, affirming the usefulness of the FNAC, in cases where histopathological follow up was available. The study underscores the importance of FNAC as a simple, minimally invasive, cost-effective and reliable initial test in evaluating and categorizing thyroid lesions and standardizing the Bethesda-based reporting system for communication and clinical decision making.

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