



## CYTOPATHOLOGICAL EVALUATION OF THYROID BY FINE NEEDLE ASPIRATION CYTOLOGY AND ITS ASSOCIATION WITH THYROID FUNCTION IN TERTIARY CARE CENTER

### Histopathology

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### ABSTRACT

**Background:** Thyroid swellings are common clinical findings, more prevalent in females, and most are benign. Fine-Needle Aspiration Cytology (FNAC) is a simple, cost-effective, and minimally invasive tool for differentiating benign from malignant lesions. The Bethesda System standardizes cytological reporting, improving diagnostic accuracy and clinical management. **Objective:** To evaluate thyroid lesions using FNAC and categorize them according to the Bethesda System, and to assess their association with thyroid function in a tertiary care center. **Materials and Methods:** This cross-sectional study included 180 patients presenting with diffuse or nodular thyroid enlargement at Gajra Raja Medical College, Gwalior, from May 2024 to October 2025. Thyroid function tests (TSH and FT4) were performed for all patients. Ultrasound-guided FNAC was carried out using a 23-gauge needle, and samples were analyzed according to the Bethesda System. Data were analyzed using SPSS version 25. **Results:** Patients' ages ranged from 9–72 years (mean 40.6 years), with maximum cases in the 21–40 years age group. Females predominated (91.7%), giving a female-to-male ratio of 11:1. The most common presentation was painless thyroid swelling (81.1%). According to the Bethesda System, benign lesions comprised 87.8% of cases, non-diagnostic 3.9%, AUS/FLUS 1.1%, FN/SFN 4.4%, suspicious for malignancy 1.1%, and malignant 1.7%. Among benign lesions, colloid goitre (45.6%) was most frequent, while papillary carcinoma (66.7%) predominated among malignant cases. **Conclusion:** FNAC is a reliable, safe, and cost-effective diagnostic tool for thyroid swellings. Most lesions were benign, with a marked female predominance. Bethesda reporting provides standardized, clinically meaningful categorization, guiding management and reducing unnecessary surgeries.

### KEYWORDS

Thyroid Nodules, Fine-Needle Aspiration Cytology (FNAC), Bethesda System, Papillary Carcinoma, Cytopathology

### INTRODUCTION

Thyroid swellings are a common clinical finding that affects 4-7% of the general population. The prevalence is higher in females than in males. Its frequency in iodine-deficient areas can reach up to 25%, and it rises with age, goitrogenic substances in the diet, and a history of radiation exposure [1 2]. In India, more than 42 million people have goiter, and there are more than 2 billion instances worldwide [3]. Thyroid cancer is the most prevalent endocrine system cancer, making up 1% of all cancers [4]. The majority of nodules are benign lesions, but in order to differentiate them from malignancy, a number of diagnostic tests, including USG, nuclear scan, and FNAC, are helpful in identifying patients who require surgery [5].

Thyroid diseases are the most common endocrine disorders treated by physicians in their routine practice. Thyroid lesions are easy to diagnose, as even a small swelling of the thyroid is easily visible and can be treated by the physician. It is necessary to differentiate between benign and malignant lesions because malignancy requires immediate surgery [6]. Fine-needle aspiration cytology (FNAC) is an effective tool in evaluating diffuse thyroid lesions, although there are various tests to assess thyroid gland function [7]. It is a simple, rapid, cost effective, and minimally invasive procedure used in preoperative screening to distinguish between benign and malignant lesions. The use of FNAC has significantly reduced the number of surgeries performed for thyroid lesions [8]. However, it has a few drawbacks, such as incomplete aspiration, a risk of false positives and false negatives, and the inability to distinguish between follicular adenoma and follicular carcinoma [9]. The success of FNA depends on the experience of the aspirator, skillful cytological interpretation, along with relevant clinical and radiological details [10]. However, due to a lack of standardised terminology for the cytologic diagnosis of the thyroid, FNA diagnoses, and diagnostic categories are defined differently among institutions. The Bethesda System was introduced in 2007 to standardise the reporting system for thyroid FNA specimens and was revised in the year 2017 [11]. The new recommendations included six diagnostic categories: i) non-diagnostic or unsatisfactory (ND/ UNS); ii) benign; iii) Atypia of Undetermined Significance (AUS) or FLUS; iv) FN or SFN; v) Suspicious for Malignancy (SM); and vi) malignant [11].

The study is undertaken to evaluate the advantage of FNAC as an initial investigative procedure for the diagnosis of thyroid lesions and to categorise them according to the Bethesda System, which has improved clinical significance and high predictive value.

### MATERIAL & METHODOLOGY

The study entitled "Cytopathological evaluation of thyroid by fine needle aspiration cytology and its association with thyroid function in tertiary care center" A Cross-sectional Study" was carried out as below:

**Place of Study:** The study was designed in the Department of Pathology, It was carried out in the Department of Pathology and JA Groups of Hospitals, Gajra Raja Medical College, Gwalior Madhya Pradesh.

**Period of Study:** The present study was carried out May 2024 to Oct 2025 a period of 18 months.

**Sample Size:** By reference document analysis, titled: From the study of "Yousaf, M. N., Ullah, H. et al(2023)<sup>12</sup> Among the patients studied, malignant thyroid nodules were detected on FNAC, with an overall prevalence of 21%.The formula for calculating sample size: At 95% level of significance and 6% absolute error sample size calculated using the formula:  $n = Z^2\alpha/2PQ d^2$ ,  $Z_{\alpha/2} = 1.96$  (at 95% level of significance) calculated sample size was 180 rounded.

**Inclusion Criteria:** All patients presenting with diffuse or nodular thyroid enlargement, who were subjected to FNAC (either direct or ultrasound-guided), were included in the study

**Exclusion Criteria:** Patients who had a history of thyroidectomy, thyroid cancer, or radioactive iodine treatment were excluded from the study.

**Study Procedure:** All study participants underwent a detailed clinical evaluation, including a physical examination and thyroid function tests. Thyroid function tests included the measurement of TSH and FT4 levels using standard laboratory methods. All participants also underwent ultrasound-guided FNAC of the thyroid nodules using a 23-gauge needle. Qualified pathologists handled and assessed the FNAC samples in accordance with the Bethesda System for Reporting Thyroid Cytopathology.

**Data Analysis:** Software for statistical analysis was used to examine the acquired data (SPSS version 25). The research population's clinical and demographic features were described using descriptive statistics.

**Ethical Consideration:** Ethical clearance for the study was obtained from the Institutional Ethical Committee of Gajra Raja Medical College, Gwalior (M.P.) before starting the study.

**Results**

A total of 180 patients with thyroid swelling who underwent Fine Needle Aspiration Cytology (FNAC) were included in the present study. The age of the patients ranged from 9 to 72 years, with a mean age of 40.6 years. The maximum number of cases was observed in the 21–40 years age group, accounting for 112 cases (62.2%), followed by the 41–50 years age group. There was a marked female predominance, with 165 females (91.7%) and 15 males (8.3%), giving a female-to-male ratio of 11:1

**Table 1: Age Distribution of Study Population (n = 180)**

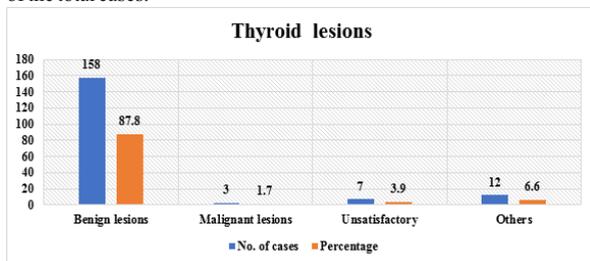
Age Group (Years)	Number of Cases	Percentage (%)
0–10	2	1.1
11–20	14	7.8
21–30	64	35.6
31–40	48	26.7
41–50	28	15.6
51–60	16	8.9
61–70	6	3.3
>70	2	1.1
Total	180	100

The most common presenting complaint was painless thyroid swelling, seen in 146 patients (81.1%). Other associated symptoms included pain or discomfort (9.4%), difficulty in swallowing (4.4%), hoarseness of voice (3.3%), and rapid increase in size (1.8%). On examination, diffuse thyroid enlargement was observed in 113 cases (62.8%), while nodular swelling was noted in 67 cases (37.2%).

**Table 2: Distribution of Thyroid Lesions According to Bethesda System (n = 180)**

Bethesda Category	Diagnosis	Number of Cases	Percentage (%)
Category I	Non-diagnostic / Unsatisfactory	7	3.9
Category II	Benign lesions	158	87.8
Category III	AUS / FLUS	2	1.1
Category IV	FN / SFN	8	4.4
Category V	Suspicious for malignancy	2	1.1
Category VI	Malignant	3	1.7
Total		180	100

Table 2 shows the distribution of thyroid lesions according to the Bethesda System. The majority of cases were benign (87.8%), while non-diagnostic smears accounted for 3.9%. Follicular neoplasm/suspicious for follicular neoplasm comprised 4.4% of cases. Malignant lesions were relatively uncommon, constituting only 1.7% of the total cases.



**Figure 1:** Showing the overall cytological spectrum of thyroid lesions, highlighting the predominance of benign conditions over indeterminate and malignant categories.

**Table 3: Cytological Spectrum of Benign Thyroid Lesions (n = 158)**

Diagnosis	Number of Cases	Percentage (%)
Colloid goitre	72	45.6
Nodular goitre	44	27.8
Hashimoto's thyroiditis	22	13.9
Lymphocytic thyroiditis	14	8.9
Granulomatous thyroiditis	3	1.9
Cystic nodule	3	1.9
Total	158	100

Table 3 depicts the spectrum of benign thyroid lesions. Colloid goitre was the most common diagnosis (45.6%), followed by nodular goitre (27.8%). Thyroiditis formed a significant proportion, with Hashimoto's thyroiditis and lymphocytic thyroiditis together accounting for nearly one-fourth of benign cases

**Table 4: Distribution of Malignant Thyroid Lesions (n = 3)**

Diagnosis	Number of Cases	Percentage (%)
Papillary carcinoma	2	66.7
Anaplastic carcinoma	1	33.3
Total	3	100

Table 4 shows the distribution of malignant thyroid lesions. Papillary carcinoma was the most frequent malignant tumor, while anaplastic carcinoma was observed in a smaller proportion of cases.

**DISCUSSION**

Fine Needle Aspiration Cytology (FNAC) is widely accepted as a first-line diagnostic tool for the evaluation of thyroid swellings due to its simplicity, cost-effectiveness, and high diagnostic accuracy. In the present study of 180 patients, thyroid lesions were more commonly seen in young and middle-aged adults, with a peak incidence in the 21–40 years age group. Similar age distribution has been reported in recent studies by Mangshetty et al. and Nandedkar et al., where the majority of patients were in the third and fourth decades of life [13,14].

A marked female predominance (female-to-male ratio of 11:1) was observed in this study, which is consistent with other Indian and international studies. Handa et al. and Mehra et al. reported a strong female preponderance, reflecting the higher prevalence of thyroid disorders among women [15,16].

Clinically, painless thyroid swelling was the most common presentation, similar to findings reported by Mondal et al. and Likhari et al., where most patients presented with asymptomatic neck swelling [16,17]. Diffuse thyroid enlargement was more frequent than nodular swelling, comparable to observations in other hospital-based studies.

According to the Bethesda System, benign lesions constituted the majority (87.8%) of cases in the present study. This finding is in close agreement with studies by Mangshetty et al. (88.15%) and Mondal et al. (87.5%), confirming that most thyroid nodules are benign in nature [13,16]. The low proportion of AUS/FLUS cases (1.1%) in this study may be attributed to adequate sampling and careful cytological interpretation, as also suggested by Likhari et al. [17].

Follicular neoplasm/suspicious for follicular neoplasm accounted for 4.4% of cases, which is comparable to rates reported by Theoharis et al. and Sarkis et al., who documented FN/SFN rates ranging from 4–6% [7,8]. Malignant lesions were relatively uncommon (1.7%), which is slightly lower but comparable to other Indian studies reporting malignancy rates between 2–5% [13,14,16].

Among benign lesions, colloid goitre was the most frequent diagnosis, followed by nodular goitre and thyroiditis. This pattern closely mirrors findings by Mehra and Nandedkar et al., where colloid goitre was the predominant benign lesion [14,15]. Papillary carcinoma was the most common malignant tumor in the present study, in agreement with almost all recent studies, confirming it as the most prevalent thyroid malignancy worldwide [13,15].

**CONCLUSION**

Fine Needle Aspiration Cytology is a simple, safe, and cost-effective diagnostic tool for the initial evaluation of thyroid swellings. In the present study, the majority of thyroid lesions were benign, with a clear female predominance and higher incidence in young and middle-aged adults. Colloid goitre was the most common benign lesion, while papillary carcinoma was the most frequent malignant tumor. The Bethesda System provided a standardized and clinically meaningful framework for reporting thyroid cytology, facilitating accurate diagnosis and appropriate patient management. Overall, FNAC proved to be a reliable screening method that helps reduce unnecessary surgical interventions and supports timely identification of malignant lesions.

**Recommendation:** FNAC with Bethesda reporting should be routinely used as the first-line investigation for thyroid swellings, and ultrasound-guided aspiration is recommended in doubtful or non-diagnostic cases to improve diagnostic accuracy.

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**Conflicts of Interest:** the authors no conflict of interest.

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