

**Precision of Fine Needle Aspiration Cytology in Evaluating Neoplastic Thyroid Lesions: A Comprehensive Diagnostic Analysis**Uzma Alvi<sup>1</sup>, Mohammed Azharuddin<sup>2</sup>, Shazima Sheereen<sup>3</sup>, Abdul Hakeem Attar<sup>4</sup><sup>1</sup>Assistant Professor, Department of Pathology, ESIC Medical College, Kalaburagi<sup>2</sup>Consultant Pathologist, Triesta HCG Cancer Hospital Kalaburagi, Karnataka, India<sup>3</sup>Consultant Pathologist, Kalaburagi, Karnataka, India<sup>4</sup>Professor Department of Pathology, ESIC Medical College, Kalaburagi

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**Abstract:**

**Background and Objectives:** Thyroid is unique in being largest endocrine organ amenable to physical examination and is affected by plethora of disorders ranging from developmental to neoplastic. After diabetes mellitus, commonest of the endocrine disorders are of thyroid gland. Solitary thyroid nodule leads to cosmetic issues, compression on adjacent organs or can have malignant potential. FNAC has been foremost diagnostic tool compared to others, requiring no admission/anesthesia. This study is done to determine age and sex distribution of thyroid lesions with clinical correlation, to evaluate diagnostic accuracy of FNAC in diagnosing neoplastic lesions of thyroid.

**Materials and Methods:** This Prospective study (June 2022 to May 2023) comprised of 50 cases, referred to ESIC Medical college and hospital Gulbarga and FNAC of neoplastic thyroid lesions were done with histopathological correlation in 50 patients and statistical analysis was performed in all cases.

**Results:** Thyroid lesions were common in age group of 31-40 years, with female predilection (83.95%), neck swelling was predominant clinically (100%) and fever and pain least common. Among the Neoplastic follicular neoplasm (14 cases; 28%), Hurthle cell adenoma (02 cases; 04%) papillary carcinoma (25 cases; 50%), medullary carcinoma (05 cases; 10%), (papillary carcinoma with Hashimoto's thyroiditis (02 cases; 04%) and anaplastic carcinoma (02 cases; 04%) were seen. When comparing FNAC and histopathology results, FNAC has a sensitivity of 93.9%, specificity of 94.1%, positive predictive value (PPV) of 96.8%, negative predictive value (NPV) of 88.8%, and an accuracy of 94.0%.

**Conclusion:** Thyroid cytology is an effective and economical initial diagnostic approach that demonstrates a high level of patient acceptance and is free from complications. Its reliability and simplicity make it a valuable tool in the diagnostic process. The ideal test should have a sensitivity and specificity of 100%. The closest method to ideal test is, thus, FNAC which has high sensitivity and specificity. The optimal approach for accurate results and avoiding mismanagement is to utilize both Fine Needle Aspiration Cytology (FNAC) and Ultrasound in combination. Thus, FNAC is followed as first line pre-operative procedure due to its simplicity, cost-effectiveness & good diagnostic accuracy.

**Keywords:** FNAC, Thyroid, Neoplastic Lesions, Precision, Histopathological Correlation.

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**Introduction**

The origin of the word thyroid can be traced back to the Greek word thyreos, which translates to shield. In 1656, it was first used by Thomas Wharton of London, who named it 'Glandular thyroideis'. A cystic mass in the neck was called struma bronchocele in ancient times while goiter (Latin word gutter meaning throat) is still used today. [1]

Thyroid is unique as it is largest, superficial of all the endocrine glands and is only one that is amenable to direct physical examination. This gland can be affected by various disorders such as developmental, inflammatory, hyperplastic, neoplastic, and may

lead to hypothyroidism, hyperthyroidism, cosmetic issues, compression in other organs, and even malignancy. [2,3]

Worldwide, 122000 individuals are affected each year and predominantly affecting females and young adults. Congenital hypothyroidism affects approximately 1 in every 2640 births. The most common endocrine malignancies are the thyroid carcinomas accounting to about 1% of the total malignancies globally. [4] Among endocrine disorders, thyroid disorders are most common and next to diabetes mellitus. The term "diffuse thyroid

lesions" refers to lesions that affect the entire gland, such as hyperplasia and thyroiditis. Nodular lesions include non-neoplastic hyperplasia, benign, and malignant tumors that create clinical nodules. A solitary thyroid nodule is a detectable mass within the thyroid gland that is separate from the surrounding tissue. They cause more concern because of high probability of malignancy in them, which can range from 5-35% of all solitary thyroid nodules. [5,6] For over 50 years, fine needle aspiration cytology has been utilized for pre-operative diagnosis and assessing thyroid nodules. This technique has led to fewer thyroidectomy procedures for patients with non-cancerous thyroid conditions. Thyroid cancer account for 1% of all cancers and 0.5% of cancer related deaths.[7,8] Fine needle aspiration cytology (FNAC) is now widely accepted as a simple, cost-effective, minimally invasive, pre-operative investigation, which can be performed on out-patient basis, and is considered the "gold standard" in the selection of patients for thyroid surgery. The prevalence of this procedure is on the rise among patients, as it is safely and widely recommended due to absence of major complications and has led to the detection of thyroid cancers at earlier stages and has also reduced the number of thyroidectomies resulting in better outcome of patients. [7,9,10]FNAC has become a common diagnostic procedure replacing other diagnostic methods as it requires no anesthesia, easy to perform and can be repeated without much discomfort to the patient and has a high diagnostic accuracy. [11] FNAC has become the preferred preoperative test for thyroid nodules due to its direct morphological information.

According to the guidelines established by the American Thyroid Association and National Comprehensive Cancer Network, the recommended initial diagnostic test is fine-needle aspiration (FNA) due to its high diagnostic accuracy and cost-effectiveness. There are various causes for thyroid malignancy like Genetic, environmental, hormonal factors. Early detection has improvised the treatment regimen and better survival. [6,12] As Fine needle aspiration cytology carries diagnostic and therapeutic significance, this study was conducted in our institution to diagnose various thyroid lesions .

### Aims & Objectives

1. The purpose of this study is to assess how accurately fine needle aspiration cytology (FNAC) diagnoses thyroid lesions.
2. To correlate clinically and study the age and sex distribution of various lesions of thyroid
3. To correlate the cytological and histopathological findings of thyroid lesions wherever possible, in patients ESIC Medical college and Hospital Gulbarga

### Materials and Methods

The present study 'Precision of Fine Needle Aspiration Cytology in Evaluating Thyroid Swellings: A Comprehensive Diagnostic Analysis "was a prospective study carried out during JUNE 2022.

A total number of 50 cases were included in the study which comprises of all the patients with thyroid swelling attending ESIC Medical college and Hospital Gulbarga The average number of FNAC passes recommended for adequate sampling of thyroid swelling is two to five. Air dried smears were stained with May-Grunwald - Giemsa (MGG) and Hematoxylin and Eosin stains. Papanicolaou staining was used wherever necessary, after the smears were fixed in ethyl alcohol / isopropyl alcohol. Whenever fluid was obtained, all the contents was aspirated using a syringe attached to the aspiration needle. Later it was centrifuged and smears were prepared from the sediment and stained by the stains, mentioned earlier. Operated thyroid specimens were collected and immersed in 10 % formalin in fresh state and allowed to fix for 24 hours. Detailed Gross examination was done and representative bits were allowed for routine histopathological processing. Paraffin stained sections obtained were studied under light microscope, after haematoxylin and eosin staining. Cytological diagnosis was compared to histopathology and FNAC efficacy was estimated using Galen and Gambino methodology.

### Inclusion criteria:

- All patients presenting with thyroid swelling in whom FNAC was indicated.
- Patients aged between 7 – 70 years were included in the study
- Patients whose cytological smears indicate malignant.

### Exclusion criteria:

- Patients with swellings in the neck other than that of thyroid gland
- Patients aged <7 and >70 years were excluded in the study as there was refusal for the procedure.
- Patients with thyroid swelling in whom there was inadequate aspirate, were excluded from the study.
- Patients with benign cytological smears.

### Results

The present prospective study was carried out in Department of Pathology over a period of one year from June 2022 to May 2023. The study comprised of a total number of 50 cases.

**Table 1: Demonstrates the age incidence of thyroid lesions.**

Age	Malignant lesion of thyroid gland
7 years	Papillary carcinoma
70 years	Anaplastic carcinoma

The age of the youngest patient in this series was seven years, with a cytological diagnosis of papillary carcinoma, whereas the oldest patient was 70 years, with a cytological diagnosis of anaplastic carcinoma.

**Table 2: Demonstrates gender distribution**

Gender	Cases	Percentage
Female	42	83.95%
Male	08	16.05%

The thyroid lesions were more common in females (42 cases; 83.95%) than males (08 cases; 16.05%), with F: M ratio of 5.2 :1

**Table 3: Demonstrates the site involved**

Site	Cases	Percentage
Right lobe	46	92.85 %
Left lobe with Isthmus	04	7.15%

The most common site involved was the right lobe (46 cases; 92.85%), and the least common was the left lobe with isthmus (04 cases; 7.15%).

**Table 4: Demonstrates the consistency of lesions on palpation**

Consistency	Cases	Percentage
Firm	46	92.85%
Swelling with cystic consistency	04	7.15%

The maximum number of thyroid lesions were firm in consistency (46 cases; 92.85%), and the least common was swelling with cystic consistency (04 cases; 7.15%).

**Table 5: Shows the classification of thyroid neoplasm. NEOPLASTIC:**

Benign	Follicular neoplasm	14 cases	28%
	Hurthle cell neoplasm	02 cases	04%
Malignant	Papillary carcinoma	25 cases	50%
	Papillary carcinoma with hashimotos thyroiditis	02 cases	04%
	Anaplastic carcinoma	02 cases	04%
	Medullary carcinoma	05 cases	10%
	TOTAL	50 cases	100%

**Table 6: Age range in neoplastic lesions**

Neoplastic lesions	Age range
Papillary carcinoma	25-58 years
Follicular neoplasm	25-58 years
Medullary carcinoma	45-50 years
Anaplastic carcinoma	60 to 70 years

Papillary carcinoma ( 25 cases;50%) was most frequently seen in 21-30 years with age range between 25-58 years and mean age was  $40.36 \pm 11.46$  , whereas follicular neoplasm ( 14 cases;28%) was seen in the age group 21-30 years with age range of 19-45 years and mean age was  $37.33 \pm 6.98$  with male to female ratio of 1:2, medullary carcinoma was seen in the age range of 45-50 years with mean age of 45 years and a solitary case of anaplastic carcinoma was seen in the age range of 60 to 70 years .

**Table 7: Shows the correlation of cytologically diagnosed cases with histopathology**

Papillary carcinoma	25	23-papillary carcinoma 2-nodular goiter	25
Medullary carcinoma	05	05-medullary carcinoma	05
Anaplastic carcinoma	02	02- anaplastic carcinoma	02
Papillary carcinoma with Hashimoto's	02	1-papillary ca 1-Hashimoto's thyroiditis	02
Follicular neoplasm	14	14	14
Hurthle cell neoplasm	02	02	02

All 50 cases had good histopathology correlation comprising of different spectrum of thyroid lesion; ,papillary carcinoma (25 cases;50%), medullary carcinoma (05 case;10%) and anaplastic carcinoma (02 case;04%). 3 cases

did not correlated on histopathology, which were diagnosed as papillary carcinoma on cytology turned out to be nodular goiter on histopathology.

**Table 8: Shows the statistical index.**

Statilcal index	No of cases	Percentage
True positive	31	62%
True negative	16	32%
False positive	01	02%
False negative	02	04%

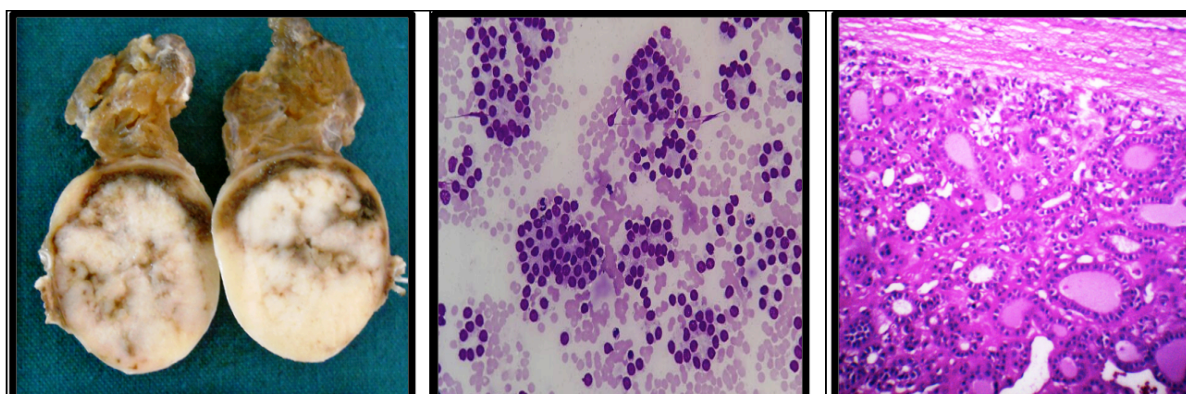
Out of 50 patients, 31cases (62%) diagnosed as malignant on cytology, turned out to be malignant on histopathology and hence were considered as true positive cases, 16 cases (32%) had benign cytological finding on FNA and the same were confirmed by histopathological examination, which represented true negative cases. There were 02 cases (4.23%) diagnosed as benign by FNA which turned out to be malignant on histopathological examination representing false negative cases and there were 02 case (4%) cytologically diagnosed as malignant, but turned out to be benign on histopathological examination, thus representing false positive cases.

Table 9: Shows the statistical values of thyroid lesions calculated by Galen and Gambino’s method.

The majority of lesions were true negative (38 cases; 76.06%), followed by true positive (09 cases;16.90%), false negative ( 02 cases;4.23%) and false positive ( 01 case;2.81%). Following statistical analysis was noted.

$\chi^2 = 38.96$ ,  $p < 0.0001$ , Sensitivity = 93.9%, Specificity = 94.1%, PPV = 96.8.7%, NPV = 88.88%, Diagnostic accuracy = 94.0%.

**Follicular Neoplasm**

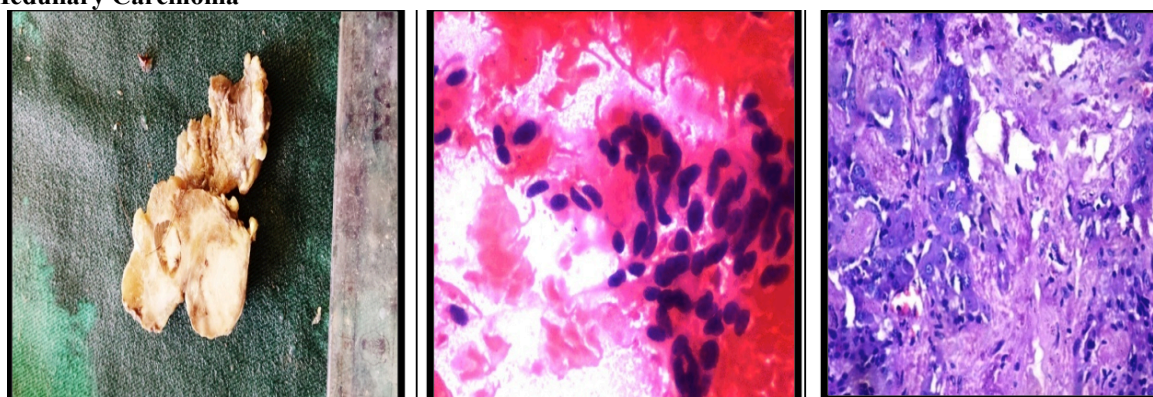


**Figure 1: A- Cut section: well circumscribed nodule with compressed adjacent thyroid tissue.**

**B- Microscopy: acinar pattern with microfollicular. (H & E 10X).**

**C- Microscopy: encapsulated tumour mass showing compressed adjacent normal thyroid tissue. (H & E 40X).**

**Medullary Carcinoma**

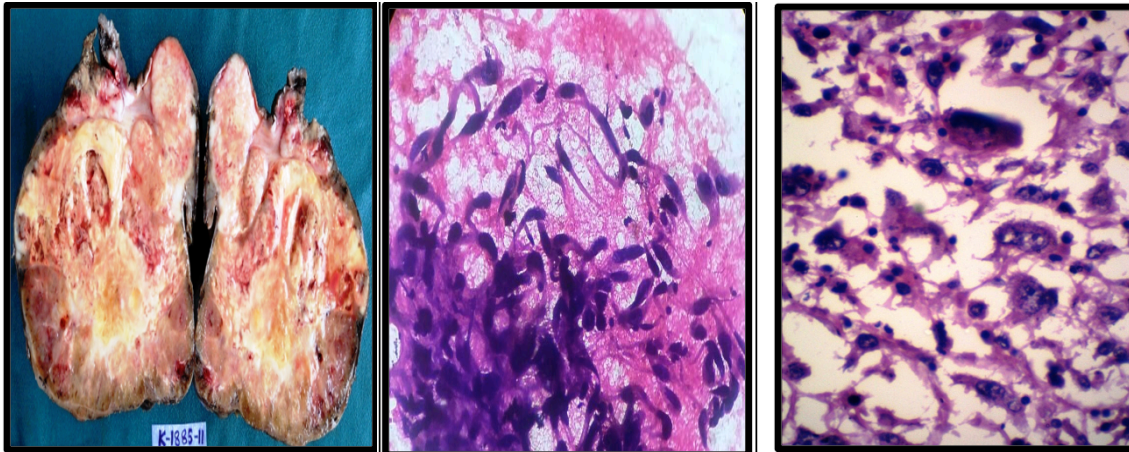


**Figure 2: A - Cut section showing nonencapsulated solid grey, tan yellow firm growth.**

**B- Microscopy: Medullary carcinoma of the thyroid (H & E 10X).**

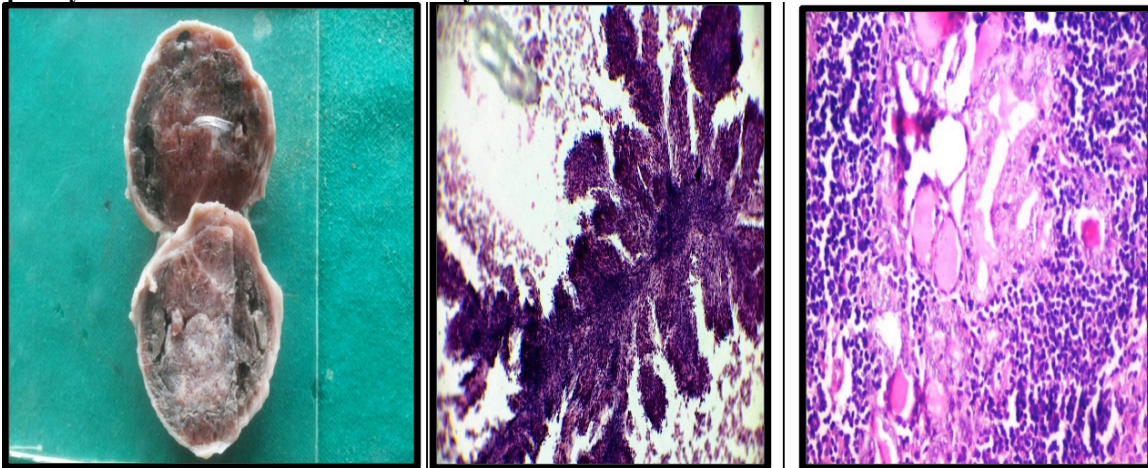
**C- Amyloid with spindle-shaped cells with a nucleus showing granular chromatin. (H & E 40X).**

**Anaplastic Carcinoma**



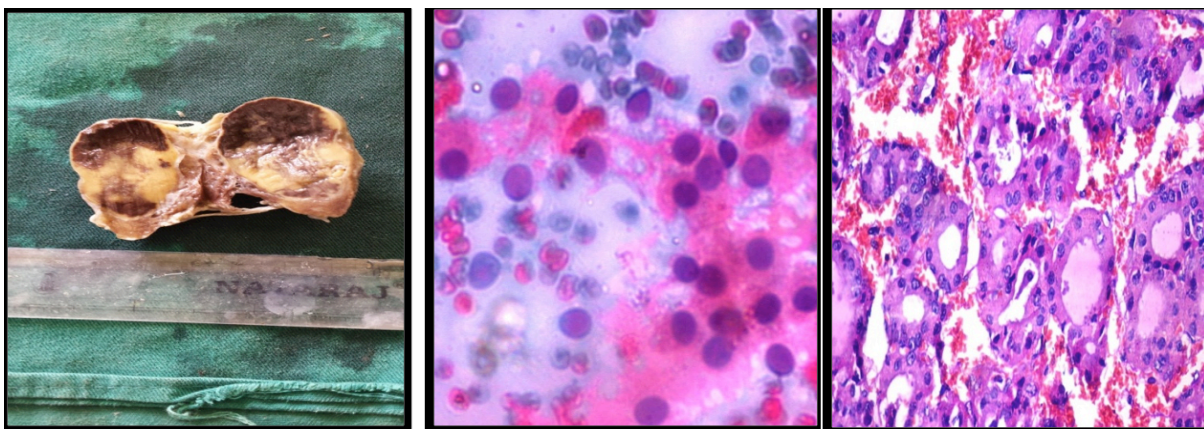
**Figure 3:** A- Cut section showing solid encapsulated tumour with areas of haemorrhage and necrosis.  
 B- Microscopy: Spindle cells with the giant cells (H&E 10X).  
 C- Microscopy: Spindle-shaped pleomorphic tumour cells (H&E 40X)

**Papillary Carcinoma with Hashimoto’s Thyroiditis**



**Figure 4:** A- Cut section showing in regular growth with areas of necrosis with Hashimoto’s Thyroiditis.  
 B- Microscopy: Papillary carcinoma: cells arranged in papillae (MGG 10X).  
 C- Microscopy: Papillary carcinoma with Hashimoto’s thyroiditis: Lymphocytes and ground glass appearance of nuclei (H & E 40X).

**Hurthle Cell Neoplasm**



**Figure 5:** A- Cut section: Solid, tan, encapsulated growth.  
 B- Microscopy; Hurthle cell adenoma (H&E 10X).

C- Microscopy: Hurthle cell adenoma: Hurthle cells with abundant granular eosinophilic (H & E 40X).  
**Discussion**

The age of the patients in this study ranged from 7 to 70 years with a mean age of  $35.21 \pm 12.56$  years, which almost correlated with study of patel et al and the mean age was lower when compared with the studies conducted by Ujwala s. chavan et al, Asri mutali et al, Fatemeh Hajmanoochehril et al and Pinkey pandey et [3,13,14,15,16]

In this study, the gender distribution showed a significant preponderance of female cases (83.95%) compared to male cases (16.05%). Based on the data analysis, it was found that there were approximately 5.2 females for every 1 male in the population, which corroborated well when compared with similar study conducted by fatemeh hajmanoochehri et al where it was 1:5.3, whereas it was lower when compared to patel et al and Ujwala s. chavan et al and higher when compared to Asri mutali et al.[3,13,14,15] In the present study, the consistency of cases on palpation were mostly firm (31 cases; 74.07%) followed by those (05 cases; 12.35%) with hard in consistency, soft (05 cases; 11.72%) and few were cystic (01 case; 1.86%) and these findings correlated well with the study of Arun sen gupta et al.[10,17,18] In our study, the most frequent neoplastic lesion was papillary carcinoma, accounting for 50% of cases. This is consistent with the findings of Gulia et al, who reported 6.43% of cases as papillary carcinoma. In our study, out of the 25 cases of papillary carcinoma of thyroid, one case(0.61%) was associated with Hashimoto's thyroiditis and this finding was relatively similar to the study conducted by S Lakshmi et al, where they encountered 2 (2.78%)out of 7 cases of papillary carcinoma of the thyroid.[19,20]

Follicular neoplasm (14 cases; 28%) was next frequent in the study and was lower when compared with the study conducted by Ujjawal et al and patel et al. Other few cases constituted medullary carcinoma (05 cases; 10%) and anaplastic carcinoma ( 2 case; 04%) in the present study, similar to the study conducted by Sinna E. A et al and patel et al respectively where they had 6 (2.07%) cases of medullary carcinoma and a single case (0.8%) of anaplastic carcinoma [13,21] Out of 50 patients, 45 cases (90.47%) diagnosed as malignant on cytology, turned out to be malignant on histopathology and hence were considered as true positive cases, and there were 05 cases (9.53%) cytologically diagnosed as malignant, but turned out to be benign on histopathological examination, thus representing false positive cases.

True positive cases were almost similar to Nasib Chand et al and it was higher when compared to Arun Sen Gupta and Khan et al. True negative cases were almost similar to Nasib Chand et al Our study was in comparison with khan et al but when compared to Nasib Chand et al there were more true negative cases.[22]

Statistical analysis of present study ie PPV of 85.7%, NPV of 94.7%, sensitivity of 80%, specificity of 96.4% and diagnostic accuracy of 93%was in comparison with other studies where PPV was almost similar to Nasib Chand et al, Khan et al and Sinna et al, it was higher when compared to Mamoon et al . NPV was almost similar to all the studies mentioned in the above table, Sensitivity was similar to Nasib Chand et al, Khan et al, Mamoon et al and it was lower when compared to Sinna et al. Specificity was similar to Nasib chand et al, Khan et al, Sinna et al and it was higher when compared to Mamoon et al. Diagnostic accuracy was almost similar to Nasib Chand et al, Sinna et al, Khan et al and it was higher when compared to Mamoon et al, [21,22,23,24]

### Conclusion

The field of diagnostic cytopathology has been rapidly evolving, with Fine Needle Aspiration Cytology (FNAC) being a prominent advancement. Despite the independence that cytopathology has gained as a specialization, FNAC continues to be the preferred method for investigating and diagnosing both superficial and deep-seated lesions. This technique employs a fine needle to extract cells from the lesion for microscopic examination, providing a minimally invasive yet highly accurate diagnostic tool for healthcare professionals.

Fine-needle aspiration cytology (FNAC) is a highly reliable and cost-effective method for distinguishing between benign and malignant thyroid nodules. It is widely accepted as the most accurate diagnostic procedure for this purpose and can aid in the preoperative selection of patients for surgery. This method can be repeated when required as this is an opd procedure carrying low morbidity, and in cases of Hashimoto's thyroiditis, they can be excluded from undergoing surgery, as these cases can be treated medically. FNAC is the most reliable diagnostic tool due to its high predictive value, rapidity, simplicity, lack of risk, and high accuracy in detecting thyroid lesions.

All the FNAC diagnoses must be viewed in the light of the clinical pictures and other related investigations to minimize the risks of false negative reports.

The most common malignant lesion among neoplastic lesions was papillary carcinoma (50%). FNAC should be treated as a first-line of diagnostic tool for thyroid swelling, while this technique is not a substitute for conventional surgical histopathology.

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