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ORIGINAL ARTICLE

# Cytomorphological evaluation and diagnostic patterns in FNAC specimens: Insights from 251 case evaluations.

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**ABSTRACT… Objective:** To examine the cytologic appearances, diagnostic distribution, and clinical aspects of the FNAC reports of a tertiary care pathology unit. **Study Design:** Retrospective Observational study. **Setting:** Department of Pathology, Indus Medical College and Hospital, The University of Modern Sciences, Tando Muhammad Khan. **Period:** April 2019 to April 2025. **Methods:** A total of 251 FNAC reports were retrospectively analysed. Cases were classified according to cytology diagnosis and type of lesion; site of the anatomy; demographics of the patient and guidelines to treatment. The descriptive statistics and cross-tabulation were conducted to determine patterns and associations of diagnoses. The research was approved by our institutional ethical review board. **Inclusion Criteria:** FNAC reports with complete clinical information and adequate cytological material. Patients of all ages and both genders. **Exclusion Criteria:** FNAC reports with inadequate or non-diagnostic samples. Cases lacking essential demographic or clinical information. Repeated FNACs from the same lesion during the study period (only the first adequate sample was included). **Results:** The sample had 168 females (66.9%) and 83 males (33.07%) with an average age of 36.60 +- 18.41 years. The most frequent types of the diagnosis included benign lesion (28.8%), malignant lesion (18.4%), and inflammatory conditions (14.0%). The tuberculous lymphadenitis was identified to be 12.0%. The most sampled anatomic sites were cervical lymph nodes (22.3%) and breast (18.7%). The malignancy rate of definite diagnoses was 18.4% with the mean age of malignancy at 46.8 years as compared to 36.9 years in benign lesions. **Conclusion:** FNAC shows high levels of usefulness in the classification of various pathological lesions with different cytomorphological features. The epidemiological concerns of the area are underscored in the high rate of tuberculous lymphadenitis in this series. Histopathological correlation and standardized reporting systems are necessary to achieve the best possible diagnostic accuracy and patient management.

**Key words:** Breast Lesions, Cytomorphological Patterns, Diagnostic Categories, Fine Needle Aspiration Cytology, Tuberculous Lymphadenitis, Thyroid Nodules.

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## INTRODUCTION

FNAC has become one of the new pillars of diagnostic modalities in modern clinical practice and provides a fast, minimally invasive, and cost-saving way of assessing palpable masses and suspicious lesions.[1] FNAC has been shown to have a diagnostic accuracy of 87 to 98% in different anatomical locations with high sensitivity (80-98%) and specificity (96-100%)- detecting benign and malignant lesions after it became widely used in diagnosing lesions. It includes two steps; first, cellular material is aspired with a fine gauge needle and cytomorphological analysis of the prepared smears is done to make a diagnosis.[2,3]

Regarding the diagnostic accuracy and elimination of unnecessary surgical operations, the inclusion of FNAC in the arsenal of the so-called triple assessment of breast lesions spanned by clinical examination and radiographic tests has greatly enhanced the accuracy of the diagnosis and helped to avoid unnecessary surgical interventions.[4] Likewise, in thyroid pathology ultrasonography-guided FNAC has now become the first-line screening test of nodular disease in which standardized reporting systems, including the Bethesda System for Reporting Thyroid Cytopathology, offer risk-stratified management plans.[5] FNAC is a safe and fast method of diagnosis of lymphadenopathy, an effective method of distinguishing between reactive, infectious, and neoplastic processes and limiting the use of excisional biopsies.[6]

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Although it possesses many benefits, FNAC also has intrinsic drawbacks of poor sampling rates (2-20 percent of cases), a difficulty in differentiating some lesions of the follicular thyroid, and variation in quality of the sample based on who does the procedure.[7] Standardized reporting systems, such as the Bethesda System of thyroid, the International Academy of Cytology (IAC) Yokohama System of breast and the Sydney System of lymph nodes have improved reproducibility, and have led to easier communication between cytopathologists and clinicians.[8]

In this retrospective study, the categorisation and analysis of cytomorphological patterns present in FNAC reports in a tertiary care laboratory will be performed in a comprehensive way, covering demographic features, distribution of anatomical sites, diagnostic categories, and treatment recommendations to provide contribution in the context of literature that exists with regard to the patterns of FNAC use and diagnostic spectrum.

## METHODS

### Study Design and Setting

The study was a retrospective observational study done on the FNAC reports in the cytopathology laboratory, Department of Pathology, Indus Medical College and Hospital, The University of Modern Sciences, Tando Muhammad Khan after approval from ethical committee (TUMS/ERC/2025/017). All the cases of FNAC done between April 2019 and April 2025 were included in the study with all the data being fully documented in terms of patient demographics, clinical presentation, cytological diagnosis, and treatment advice.

### Data Collection

A sample of 251 successive FNAC cases was sampled by the laboratory information system. Data extracted included:

- Demographic information about patients: age, gender.
- Clinical data: location/site of the lesion anatomically.
- Cytology results: Diagnosis and the type of lesion FNAC.
- Classification Diagnostic categorization: benign, malignant, inflammatory, infectious, cystic, tuberculous, or inconclusive.
- Recommendations of treatment: surgical excision, medical treatment, requirement of biopsy, or conservatory treatment.
- Temporal data: the year of diagnosis.

### FNAC Technique

The fine needle aspiration was done by 23–25-gauge needle with or without ultrasound guidance based on the location and palpability of the lesions. The aspirated samples were applied to glass slides and staining techniques such as Papanicolaou and Giemsa stains were used. Adequacy was determined in terms of the availability of adequate cellular material that could be interpreted as diagnostic.

### Diagnostic Categorization

Cytological diagnoses were categorized into seven major groups:

1 Benign: Non-cancerous and benign atypical neoplastic lesions.
2 Malignant: Lesions that had definite cytomorphological appearances of malignancy.
3 Inflammatory: Non-infectious inflammatory diseases such as reactive lymphadenitis.
4 Tuberculosis: Granulomatous lymphadenitis, which is in keeping with tuberculous aetiology.
5 Infective: Suppurative and abscess-forming.
6 Cyst: Cystic lesion such as colloid cysts and epidermal inclusion cysts.
7 Inconclusive: Cases of abnormal features that need upgrading.

The type of lesions was grouped by the usual cytopathological nomenclature with additions of the items of the existing report systems where possible.

### Statistical Analysis

It was determined that descriptive statistics were determined such as frequencies, percentages, means, medians, and standard deviations. Cross-tabulation tests were conducted to assess the relationships between categories of diagnoses and demographics (age, gender), site of anatomy, and treatment recommendations. The following age groups were used: 0-18, 19-30, 31-40, 41-50, 51-60, and ≥60 years.

## RESULTS

### Demographic Characteristics

The cohort of the study included 251 patients (168 females, 66.9%, and 83 males, 33.07%) which resulted in female to male ratio of 2.02:1. The average was 36.60 +- 18.41 years (median: 35 years; minimum: 2-maximum: 110 years). The age distribution showed maximum incidence in the age group of 19-30 years (28.5% n=71) and then in the age group 31-40 years (18.9% n=47).

Paediatric patients (0-18 years) formed 15.3% (n=38) of the cohort and old patients (>60 years) formed 10.4% (n=26). The bimodal distribution indicates that there are different patterns of the disease in the young and middle-aged population.

### Distribution of Diagnostic Categories

A cytological assessment produced seven diagnostic categories as shown:
Allocation of FNAC diagnostic categories with the highest count of benign lesions and the subsequent number with malignant lesions

- Benign lesions: 72 cases (28.8%)
- Malignant lesions: 46 cases (18.4%)
- Inflammatory conditions: 35 cases (14.0%)
- Tuberculous lymphadenitis: 30 cases (12.0%)
- Infective lesions: 26 cases (10.4%)
- Cysts: 22 cases (8.8%)
- Inconclusive diagnoses: 19 cases (7.6%)

The prevalence of benign diagnoses are in line with other world literature on FNAC in which benign lesions normally have 60-70% of the diagnoses. The cancer rate of 18.4 is within the range of expectations of mixed-site FNAC studies. It is important to note that the combined infectious/ inflammatory/tuberculous categories were 36.4 percent of the cases indicating the epidemiological characteristics of the region with high burden of tuberculosis.

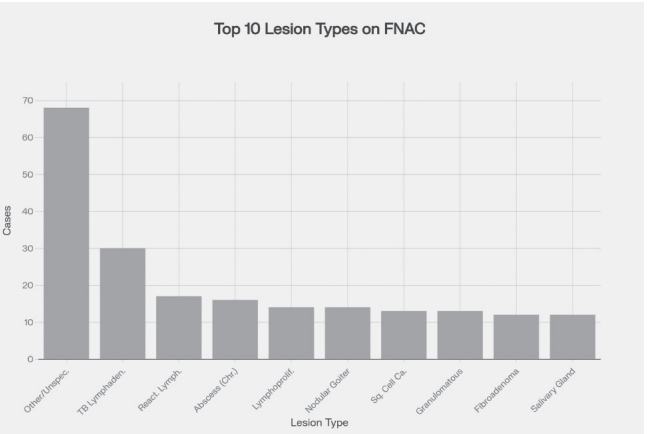
### Types of Lesions

A total of nineteen different types of lesions were recognized, the most frequent of them being:

1 Other/Unspecified: 68 cases (27.1%)
2 Tuberculous lymphadenitis: 30 cases (12.0%)
3 Reactive lymphadenitis: 17 cases (6.8%)
4 Abscess (Chronic/Cold): 16 cases (6.4%)
5 Lymphoproliferative disorder: 14 cases (5.6%)
6 Nodular goiter (Thyroid): 14 cases (5.6%)
7 Squamous cell carcinoma: 13 cases (5.2%)
8 Granulomatous lesion: 13 cases (5.2%)
9 Fibroadenoma (Breast): 12 cases (4.8%)
10 Salivary gland lesion: 12 cases (4.8%)

**FIGURE-1**

**Most frequent (top 10) lesions, found on FNAC.**




The category Other/Unspecified included benign lesions which could not be placed in a definite diagnostic entity as a result of the difficulty of subclassifying definitely on cytomorphology alone - a known limitation of FNAC. The most widespread specific diagnosis was tuberculous lymphadenitis, which is in line with high prevalence rates of tuberculosis in endemic areas.

### Anatomical Site Distribution

The cervical region/lymph nodes represented the most frequently sampled site (22.3%, n=56), followed by breast (18.7%, n=47), unspecified neck locations (13.1%, n=33), and thyroid (11.6%, n=29). The preponderance of head and neck sites reflects the accessibility of these locations to FNAC and the clinical significance of cervical lymphadenopathy in differential diagnosis.

### Site-Specific Diagnostic Patterns

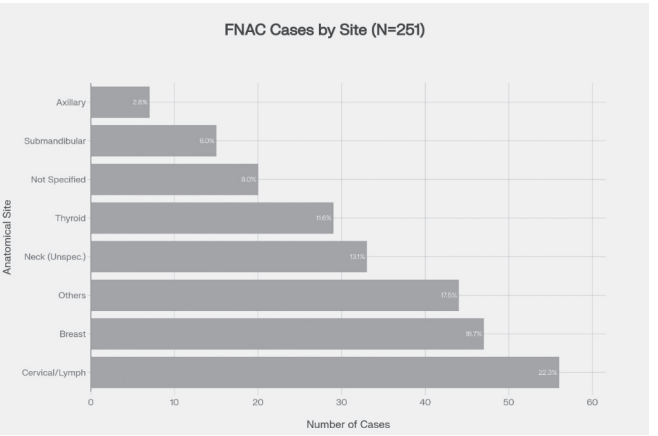
#### Breast Lesions (n=47)

The distribution of the breast aspirates was as follows: benign lesions (63.8%), malignant lesions (12.8%), infectious/inflammatory conditions (17.0%), and cysts (2.1%). The top-ranked specific

diagnoses were unspecified benign lesions (n =25), fibroadenoma (n =12), chronic/cold abscess (n = 4) and ductal carcinoma (n=2). The fact that fibroadenomas are the most frequent benign tumor of the breast among young women is in line with the high percentage of fibroadenomas. The findings of other studies were in correlation with other studies in Pakistan.[9,10]

**FIGURE-2**

**Distribution of anatomical sites of FNAC.**




The accuracy of breast FNAC in literature is 93.8 to 98.2%, sensitivity is 90.9 to 100% and specificity is 97.67 to 100%. These positive performance features make it possible to continue the use of FNAC in breast triple assessment even given the rise in the practice of core needle biopsy.

### Thyroid Lesions (n=29)

Benign (48.3) and cysts (31.0) as well as inflammatory lesions (17.2) were the most common thyroid aspirates. Nodular goiter (n =13, 44.8%), colloid cyst (n =8; 27.6), and unspecified benign lesions (n =7, 24.1) were the most common ones. This subset did not significantly have malignant lesions of the thyroid but one case was classified as immunological features (probably thyroiditis).

### Cervical Lymph Nodes (n=56)

The lymph node aspirates were very diverse: tuberculous lymphadenitis (39.3%), inconclusive (16.1%), infectious lesions (10.7%), inflammatory (10.7) malignant lesions (10.7) and benign lesions (10.7). The overwhelming prevalence of tuberculosis indicates the fact that it is the major issue of chronic lymphadenopathy in endemic areas.

FNAC in tuberculous lymphadenitis has a sensitivity between 72-97% and specificity between 72.2-100% as it relates to clinical and microbiological results. These cytomorphological patterns comprise of epithelioid granulomas, caseous necrosis, and Langhans giant cells whereby acid-fast bacilli (AFB) is positive in 21-73.5% cases according to stage and pattern of the disease.

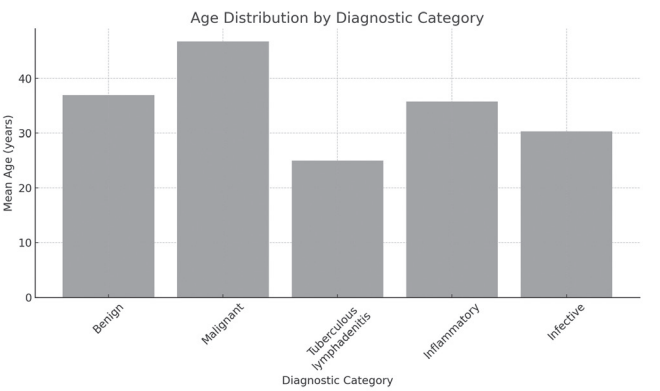
### Age Distribution by Diagnostic Category

Age variance was found to be significantly different in relation to the types of diagnoses:

- Benign lesions: Mean age 36.9 years (median 33 years, range 15-80 years)
- Malignant lesions: Mean age 46.8 years (median 45 years, range 10-110 years)
- Tuberculous lymphadenitis: Mean age 25.0 years (median 18.5 years, range 5-70 years)
- Inflammatory lesions: Mean age 35.8 years (median 40 years, range 2-70 years)
- Infective lesions: Mean age 30.3 years (median 25 years, range 3-70 years)

**FIGURE-3**

**Age distribution by diagnostic category**




Paediatric, Children to Teen (0-18): Tuberculous lymphadenitis (7 cases) and fibroadenoma (3 cases, female).

Young Adult (19-30): nodular goiter (5 female cases) and Tuberculous lymphadenitis (20 cases).

Middle Age (31-40): Squamous cell carcinoma develops (5 female cases) and the lymphoblastic disorders are still present (4 male cases).

Older Adult (41-50): Squamous cell carcinoma has

the highest (10 cases overall) with abscess and lymphoblastic disorder.
Elderly (51-60+): Few cases (8 in total) of squamous cell carcinoma and lesions of the salivary gland.

### Gender Distribution by Diagnostic Category

Most of the diagnostic types were dominated by female patients, especially in benign lesions (77.8% female) and cysts (54.5% female). Nonetheless, malignant lesions were more gender balanced (47.8 female, 52.2 male) with males slightly having a greater absolute number of malignancies (n=24 vs. n=22). This could be in line with the sampling of the male dominant malignancies like head and neck squamous cell carcinoma.

The incidence of all cases of fibroadenoma was in females (n=12), which is in line with their hormonal aetiology as well as being completely restricted to the female tissue of the breast. There was a female preponderance in tuberculous lymphadenitis (60.0% female) in line with the epidemiological research indicating that gender distribution variability is subject to regional influences.

### Treatment Recommendations

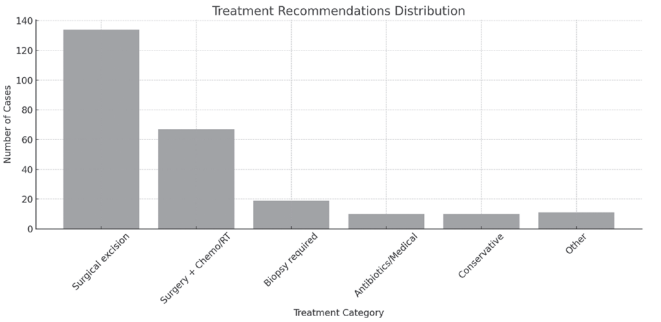
Recommendation of treatment stratified the cohort into six categories:

1 Surgical excision: 134 cases (53.4%)
2 Surgery with adjuvant chemo/radiotherapy: 67 cases (26.7%)
3 Biopsy required for further evaluation: 19 cases (7.6%)
4 Antibiotics/medical management: 10 cases (4.0%)
5 Conservative management: 10 cases (4.0%)
6 Other interventions: 11 cases (4.4%)

The manner of high percentage of surgical recommendations (80.1% a combination of surgical excision and surgery with adjuvant therapy) relates to the diagnostic spectrum, in which a certain pathological characterization and treatment frequently require tissue removal. The suggestion of further biopsy in 7.6% of cases highlights the weaknesses of FNAC in some cases especially indeterminate or atypical lesions that need histoarchitectural evaluation.

**FIGURE-4**

**Treatment recommendations distribution**




### Temporal Trends

Temporal analysis showed the unstable number of cases throughout years: 2023 (n=53, 21.1%), 2024 (n=51, 20.3%), 2022 (n=31, 12.4%), 2021 (n=29, 11.6%), 2025 (n=20, 8.0%), 2019 (n=19, 7.6%), and 2020 (A big percentage (n=36, 14.3) was unknown year of designation. The greater number of cases of 2023-2024 could indicate more effective laboratory capacity, greater clinical use of FNAC or better documentation practices.

## DISCUSSION

### Peak Incidence Age Group

The peak age of case load of 19-30 years age bracket (30 cases, 35.3% of total) was dominated by tuberculous lymphadenitis (20 cases) both in females and males and is the metric of endemic tuberculosis disease burden. These high percent of females were similar to the studies worldwide.[11]

### Gender Pattern

The trend of female dominance is uniform throughout all age groups with a ratio between female and male standing at 1.83 : 1 in general. Nonetheless, certain types of lesions demonstrate particular gender distribution, the presence of fibroadenoma being the most common lesion in females in our study corelates with the other studies[12], whereas Lymphoproliferative disorders is largely in males which aligns with the study conducted in Pakistan.[13]

### Age-Dependent Lesion Shifts

Our study showed age-specific changes whereby in young population, infectious/inflammatory lesions were common. The high percentage of young

population in our study coincides with the similar findings on international levels[14], while malignant lesions common in elderly population.[15] The paper shows that FNAC has a wide diagnostic range and can be used in different anatomical structures and pathological entities. The rates of benign diagnoses are also consistent with the literature on FNAC because most lesions aspirated turn out to be non-neoplastic.[16]

**Tuberculous Lymphadenitis: Cytomorphological and Epidemiological Considerations**

The tuberculous lymphadenitis became a significant diagnostic structure (12.0% of all cases and 39.3% of cervical lymph node aspirates). Our findings of high tuberculous lymphadenitis coincide with the other local study which also finds tuberculous as the leading cause of lymphadenitis. FNAC has proven to be highly useful in the diagnosis of tuberculous lymphadenitis.[17]

**Breast Lesions: FNAC in Contemporary Practice**

The proportion of lesions of the breast was 18.7 of the cohort with fibroadenoma (25.5% of cases of the breast) and unspecified benign lesions (53.2) leading. In the modern literature, the level of diagnostic accuracy of breast FNAC is between 93.8 and 98.2 percent; sensitivity is more than 90 percent in detecting malignancy.[18]

**Thyroid Nodules**

Lesions of the thyroid included 11.6% of the cases, which were mostly benign nodular goiters and cysts colloid. The fact that no definitive malignancies are observed in this subset (0%) is different to the malignancy rates of low to high percentage, reported in the Body of knowledge regarding the Bethesda System works.[19] This difference is probably due to sampling of cases, with low-risk nodules having a large proportion of sampling.

**Lymphoproliferative Disorders: Diagnostic Challenges**

The lymphoprolliferative disorders constituted 5.6% of cases and they were mainly affecting the lymph node sites. FNAC is also limited in the diagnosis of lymphomas, as the sensitivity has a range of 72-88% and is often diagnosed as "atypical lymphoid cells" which are to be confirmed as histopathologic. These problems of diagnosis are due to overlapping cytomorphological characteristics between reactive and neoplastic lymphoid proliferations, failure to evaluate nodal architecture, and shortcomings in immunophenotyping on cytological specimens.[20] Therefore, supplementary techniques, such as flow cytometry or immunohistochemistry on cell blocks, are often indispensable for definitive classification and prognostication of lymphoproliferative disorders.[21]

**Head and Neck Squamous Cell Carcinoma**

Squamous cell carcinoma constituted 5.2% of cases which were mainly of head and neck origins. FNAC has shown very good sensitivity (83.1-94%) and specificity (91.9-100%) in identifying head and neck malignancies with exceptional accuracy in the detection of squamous cell carcinoma since it has distinct cytomorphological characteristics such as dyskeratosis, high nuclear-cytoplasmic ratios and necrotic backgrounds. Studies show that this malignancy metastasizes to the cervical lymph nodes.[22]

**Strengths and Limitations of This Study**

**Strengths**

The article has offered a detailed labeling of a vast FNAC series (n=251) of different anatomical locations and pathological masses. The site-specific, temporal, and demographic analytic insights provided by the study are helpful in understanding the patterns of FNAC utilization and diagnostic spectrum. The low prevalence of TB recorded in this area leads to insights into the trends of FNAC in endemic areas.

**LIMITATIONS**

The retrospective study design does not allow the collection of clinical follow up, histopathological correlation, and comprehensive descriptions of cytomorphology. Risk stratification and reproducibility is restricted by the lack of standardized reporting systems being used.[23] Other/Unspecified category (27.1% of the lesion types) is a measure of diagnostic heterogeneity but does not allow a clear characterization of the lesions. The lack of such records (Case IDs, sites, dates) can lead to selection bias. Lastly, the research does not have sensitivity and specificity calculation because there

is no systematic histological correlation.

**Limitations of FNAC: Inadequate Samples and Diagnostic Pitfalls**

Poor or non-diagnostic samples is a long-standing issue in FNAC practice with most reports ranging between 2-32% based on operator experience, lesion histories and adequate criteria. No cases in this series were specifically classified as non-diagnostic; the 7.6% rate of inconclusive implies that some cases in the 7.6% range may be hypocellular or somewhat technically inadequate. Such factors as adequacy depend on the aspirator skill, lesion vascularity and cystic content, the preparation technique, and the experience of the cytopathologist. Research has shown that the inadequacy rates are significantly lower when FNAC is done by cytopathologists.[24] Other FNAC limitations are the inability to differentiate follicular adenoma and carcinoma (where capsular/vascular invasion needs to be assessed on histology), difficulty distinguishing well differentiated malignancies, sampling error in heterogeneous lesions and interpretative problems with atypical but non diagnostic cytology.[25] Such restrictions require clinical correlation, repeat of non-diagnostic sample aspiration and tissue biopsy of indeterminate or discordant cases.

**Future Directions**

Prospective cytological-histological correlation will be included in the future research to compute diagnostic performance values (sensitivity, specificity, positive/negative predictive values) of each anatomical location and type of lesion. The use of standardized reporting systems should be given priority in order to increase reproducibility and be able to compare the results with international literature. Combination of ancillary methods such as immunocytochemistry, flow cytometry and molecular testing on FNAC samples would increase diagnostic capacity, especially on lymphoprolliferative disorders and selection of targeted therapy.

Quality improvement programs would be implemented to train the operators and enhance adequacy of specimen, which would decrease the non-diagnostic rates and enhance the overall accuracy in diagnosis. In this context, FNAC would be best utilized by creating region-specific diagnostic algorithms that include findings on prevalence of tuberculosis in the area, patterns of local malignancy, and available resources.

## CONCLUSION

Such an extensive case analysis of 251 FNAC cases shows that cytological examination is widely diagnostic in a variety of anatomical locations and pathological entities. The benign lesions were the most common ones (28.8%), then malignant neoplasm was (18.4%), and a significant burden of infectious and inflammatory conditions (36.4% combined) represented the epibiotic patterns in the region. The high rate of tuberculous lymphadenitis may be regarded as a significant issue of FNAC in the area of tuberculosis (12.0% among all the cases, 39.3% among cases of lymphadenopathy).
The site-specific analysis showed some unique diagnostic features: breast lesions were usually benign fibroadenoma was the most frequent specific diagnosis; thyroid aspirates presented with nodular goiters and colloid cysts; and cervical lymph nodes presented a high prevalence of tuberculous lymphadenitis. Age stratified analysis revealed that the patients in the malignant group were significantly older (mean 46.8 years) compared to the benign and tuberculous (36.9 and 25.0 years).

FNAC is a highly valuable diagnostic instrument with quick, economical and low invasive evaluation of palpable lesions. Nevertheless, it is important to note that its application should be limited to clinical use because of its shortcomings, such as poor reliability, and limitation to interpretative issues with some types of lesions and the failure to measure histoarchitecture. Standardized reporting systems (Bethesda, IAC Yokohama, Sydney) would provide greater reproducibility, risk stratification, and clinician communication.

Further combination of FNAC with histopathological correlation, molecular diagnostics and quality assurance programs will continue to streamline its contribution in the modern diagnostic pathology to provide accurate, efficient and patient-centered care.

The references are also incorporated within the text in the form of inline citation to the web sources and

research literature used in conducting this analysis.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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| AUTHORSHIP AND CONTRIBUTION DECLARATION | |
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| 1 | **Ashok Kumar:** Study design. |
| 2 | **Azhar Iqbal:** Data analysis. |
| 3 | **Naseer Ahmed Shaikh:** Data entry. |
| 4 | **Kiran Memon:** Data collection. |
| 5 | **Mudasar Latif Memon:** Results writing. |
| 6 | **Inayatullah Memon:** Draft writing. |
| 7 | **Muhammad Iqbal Memon:** Revisions. |