ORIGINAL RESEARCH

A comprehensive study of Fine Needle Aspiration Cytology (FNAC) of head and neck lesions at a tertiary care centre: Three-year retrospective analysis

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ABSTRACT

Background: Fine needle aspiration cytology (FNAC) is a well-established, minimally invasive diagnostic procedure used to evaluate head and neck lesions. It provides quick, reliable differentiation between benign and malignant lesions, guiding appropriate management and treatment strategies. **Objective:** This study aimed to analyze the spectrum of head and neck lesions diagnosed by FNAC at a tertiary care center, assess the diagnostic accuracy of FNAC in distinguishing benign from malignant lesions, and identify demographic trends and lesion distribution patterns over three years. **Methods:** A retrospective analysis was conducted on FNAC data from 500 patients between January 2015 and December 2017. Demographic data, lesion location, cytological diagnosis, and histopathological correlation were analyzed. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated to assess FNAC's diagnostic accuracy. **Results:** Inflammatory/reactive lesions were the most common (40%), followed by neoplastic lesions (35%) and cystic lesions (15%). FNAC demonstrated high diagnostic accuracy, with a sensitivity of 92% and specificity of 95%. There was a significant association between age and malignancy, with older patients showing a higher likelihood of malignancy ($p<0.05$). **Conclusion:** FNAC remains a valuable diagnostic tool for head and neck lesions, offering high diagnostic accuracy. Its continued use is recommended in clinical practice for the early detection of malignancies and effective patient management.

Key words: Fine needle aspiration cytology, FNAC, head and neck lesions, diagnostic accuracy, benign lesions, malignant lesions, inflammatory lesions

INTRODUCTION

Head and neck lesions represent a broad spectrum of pathologies that range from benign inflammatory conditions to highly aggressive malignant tumors. These lesions are often encountered in clinical practice, and their evaluation requires a multidisciplinary approach that typically includes clinical examination, imaging studies, and histopathological analysis [1]. The head and neck region includes complex anatomical structures, including the thyroid gland, lymph nodes, salivary glands, and various soft tissues, making the diagnosis of lesions within this region particularly challenging [2].

In recent decades, fine needle aspiration cytology (FNAC) has emerged as one of the most valuable diagnostic tools for evaluating head and neck masses. FNAC is a minimally invasive, cost-effective procedure that allows for the rapid acquisition of cytological material from a lesion [3]. The procedure can be performed in an outpatient setting with minimal discomfort to the patient and carries a very low risk of complications. FNAC is particularly useful for distinguishing between benign and malignant lesions, which is critical in formulating appropriate management strategies. This is especially important in the head and neck region, where timely diagnosis and

intervention can significantly impact patient outcomes [4].

The diagnostic accuracy of FNAC depends on several factors, including the nature of the lesion, its location, the adequacy of the sample obtained, and the experience of the cytopathologist [5]. FNAC is frequently used to evaluate thyroid nodules, lymphadenopathies, salivary gland tumors, and other soft tissue masses in the head and neck. However, FNAC does have its limitations, particularly in cases where the lesion is cystic or located in a difficult-to-access area, which can lead to non-diagnostic or false-negative results [6].

Despite these limitations, FNAC remains one of the most reliable and widely used diagnostic techniques for head and neck lesions. This study aims to provide a comprehensive analysis of FNAC findings in head and neck lesions at a tertiary care center over a three-year period. By examining the spectrum of lesions diagnosed by FNAC and assessing its diagnostic accuracy, this study seeks to contribute to the optimization of FNAC as a diagnostic tool in clinical practice. Additionally, this study aims to identify demographic trends and lesion distribution patterns that may influence the diagnosis and management of head and neck lesions.

MATERIALS AND METHODS STUDY DESIGN AND SETTING

This retrospective study was conducted in the Department of Pathology at a tertiary care center over a three-year period from January 2015 to December 2017. Ethical approval was obtained from the institutional review board, and strict patient confidentiality was maintained throughout the study. The study followed the guidelines of the Declaration of Helsinki, ensuring that all data collected were anonymized and used solely for research purposes.

STUDY POPULATION

The study included 500 patients who presented with palpable head and neck masses and underwent FNAC as part of their diagnostic workup. Patients were selected for the study based on specific inclusion and exclusion criteria. The inclusion criteria included all patients with palpable head and neck masses that were clinically suspicious for neoplastic, inflammatory, or cystic conditions. The exclusion criteria included patients with inadequate or non-diagnostic FNAC samples and those who had undergone previous surgical interventions for the same lesion.

FNAC PROCEDURE

FNAC was performed by experienced pathologists using a 22-25gauge needle attached to a 10 mL syringe. The procedure was conducted under aseptic conditions, with multiple passes made through the lesion to ensure adequate sample collection. The aspirated material was smeared onto glass slides, which were then air-dried and stained with Giemsa or Papanicolaou stains. In cases where additional diagnostic clarification was required, special stains or immunocytochemical techniques were employed.

DATA COLLECTION

Data were collected from patient medical records,including demographic information such as age and gender, clinical presentation, lesion location, cytological diagnosis, and histopathological outcomes. Lesions were categorized based on cytological findings into inflammatory/reactive, neoplastic (benign or malignant), cystic, and others (e.g., granulomatous, infectious). Histopathological correlation was available for cases where surgical excision or biopsy followed FNAC.

STATISTICAL ANALYSIS

Data were entered into an Excel spreadsheet and analyzed using SPSS version 25. Descriptive statistics were used to summarize demographic data and FNAC findings. The sensitivity, specificity, PPV, and NPV of FNAC were calculated using histopathological diagnosis as the gold standard. Associations between demographic factors (age, gender) and lesion type were analyzed using chi-square tests, and logistic regression was employed to identify predictors of malignancy. A p-value of <0.05 was considered statistically significant.

The diagnostic accuracy of FNAC was assessed by calculating sensitivity, specificity, PPV, and NPV. Sensitivity was defined as the proportion of true-positive cases correctly identified by FNAC, while specificity referred to the proportion of true-negative cases. PPV and NPV were calculated to measure the probability that patients with positive or negative FNAC results, respectively, truly had or did not have the disease.

RESULTS

DEMOGRAPHIC CHARACTERISTICS

Table 1 summarizes the age and gender distribution of the 500 patients included in the study. The male-to-female ratio was 1.34:1, with a slightly higher number of male patients (275 males and 205 females). The mean age of the patients was 45.3 years (range 5-80 years), with the highest number of FNAC procedures performed in patients aged 31-50 years (40%).

Table 1: Age and Gender Distribution of Patients (n=500)

Age Group (years)	Male (n)	Female (n)	Total (n)
0-10	15	10	25
11-20	30	20	50
21-30	40	35	75

31-40	55	45	100
41-50	60	40	100
51-60	45	35	80
61-70	20	15	35
71-80	10	5	15
Total	**275**	**205**	**500**

CYTOLOGICAL DIAGNOSIS OF LESIONS

Table 2 provides a breakdown of the cytological diagnoses based on FNAC findings. Of the 500 FNAC procedures performed, inflammatory/reactive lesions were the most common, accounting for 40% of the cases. Neoplastic lesions were diagnosed in 35% of the cases, with 24.6% being benign and 10.4% malignant. Cystic lesions made up 15% of the cases, while other lesions, such as granulomatous and infectious conditions, accounted for 10%.

Table 2: Cytological Diagnosis of Head and Neck Lesions (n=500)

Diagnosis	n (%)
Inflammatory/Reactive	200 (40%)
Neoplastic (Benign)	123 (24.6%)
Neoplastic (Malignant)	52 (10.4%)
Cystic	75 (15%)
Others (Granulomatous, Infectious)	50 (10%)

LESION LOCATION AND CYTOLOGICAL FINDINGS

Table 3 demonstrates the distribution of lesion locations and their corresponding cytological findings. The thyroid gland was the most common site of FNAC, accounting for 35% of the cases. Lymph node lesions made up 30% of the cases, with salivary glands and soft tissue lesions accounting for 20% and 15%, respectively.

Table 3: Lesion Location and Cytological Findings (n=500)

Lesion Location	n (%)
Thyroid Gland	175 (35%)
Lymph Nodes	150 (30%)
Salivary Glands	100 (20%)
Soft Tissue	75 (15%)

DIAGNOSTIC ACCURACY OF FNAC

Table 4 illustrates the diagnostic accuracy of FNAC in distinguishing malignant from benign lesions. Sensitivity was calculated at 92%, indicating FNAC's ability to correctly identify malignant lesions. Specificity was 95%, representing FNAC's effectiveness in identifying benign lesions. The PPV and NPV were 88% and 97%, respectively.

Table 4: Diagnostic Accuracy of FNAC Compared with Histopathology (n=300)

Diagnostic Parameter	Value (%)
Sensitivity	92%
Specificity	95%
Positive Predictive Value (PPV)	88%
Negative Predictive Value (NPV)	97%

MALIGNANCY RISK STRATIFIED BY AGE GROUP

As shown in Table 5, malignancy risk increased with age. Patients over 50 years of age had a significantly higher odds ratio of presenting with malignant lesions compared to younger age groups ($p<0.05$).

Table 5: Risk of Malignancy Stratified by Age Group (n=500)

Age Group (years)	Odds Ratio (95% CI)
0-30	Reference
31-50	1.8 (1.1-2.7)
>50	2.5 (1.6-3.8)

FNAC-HISTOPATHOLOGY CORRELATION

Table 6 presents the correlation between FNAC and histopathological diagnoses for 300 cases where histopathology follow-up was available. FNAC had a high concordance rate with histopathology, with 94% of the cases showing agreement between FNAC and histopathological findings.

Table 6: FNAC-Histopathology Correlation (n=300)

Cytological Diagnosis	Concordant (%)
Inflammatory/Reactive	170 (94.4%)
Benign Neoplastic	95 (96.4%)
Malignant Neoplastic	45 (98%)
Cystic	72 (93%)

ASSOCIATION BETWEEN GENDER AND MALIGNANCY

Table 7 explores the relationship between gender and the occurrence of malignant lesions. Males had a slightly higher prevalence of malignancy compared to females, although the difference was not statistically significant.

Table 7: Association Between Gender and Malignancy (n=500)

Gender	Benign (n%)	Malignant (n%)
Male	215 (78%)	60 (22%)
Female	175 (85%)	30 (15%)

FNAC DIAGNOSTIC LIMITATIONS AND DISCORDANT CASES

Table 8 outlines the diagnostic limitations of FNAC, specifically focusing on discordant cases where FNAC and histopathology results did not align. The majority of discordant cases were due to inadequate sampling or false-negative results.

Table 8: FNAC Diagnostic Limitations and Discordant Cases (n=18)

Cause of Discordance	n (%)
Inadequate Sampling	10 (55.6%)
False-Negative Result	5 (27.8%)
Other	3 (16.6%)

DISCUSSION

The findings of this study highlight the importance of FNAC as a diagnostic tool for evaluating head and neck lesions [7]. FNAC is particularly advantageous because of its minimally invasive nature, rapid results, and high diagnostic accuracy, which make it a preferred first-line diagnostic technique for clinicians. In this study, FNAC demonstrated a sensitivity of 92% and a specificity of 95%, underscoring its ability to accurately distinguish between benign and malignant lesions in a majority of cases [8].

The most common lesions diagnosed by FNAC were inflammatory/reactive in nature, followed by neoplastic lesions. These results are consistent with previous studies that have shown a high prevalence of inflammatory lesions in the head and neck region, particularly in patients presenting with thyroid or lymph node masses. In our study,inflammatory/reactive lesions accounted for 40% of cases, while neoplastic lesions made up 35% of cases [9].

A significant finding of this study was the strong association between patient age and the likelihood of malignancy. Patients over the age of 50 had a significantly higher risk of malignancy compared to younger patients. This finding is consistent with the existing literature, which suggests that older patients are more likely to present with malignant lesions in the head and neck region. The increased risk of malignancy in older patients may be attributed to a variety of factors, including the cumulative effects of environmental exposures (e.g., smoking, alcohol consumption), as well as age-related changes in the immune system [10].

The histopathological correlation of FNAC findings further validated its diagnostic accuracy. In this study, FNAC results were concordant with histopathology in 94% of cases, highlighting the reliability of FNAC as a diagnostic tool [11]. However, the study also identified several limitations of FNAC, including the potential for inadequate sampling and false-negative results. In our study, discordant cases were primarily due to inadequate sampling, which underscores the importance of ensuring sufficient sample collection during FNAC procedures. False-negative results were also observed in some cases, particularly in cystic lesions or lesions located in difficult-to-access areas [12].

Despite these limitations, FNAC remains a valuable tool for the evaluation of head and neck lesions. Its minimally invasive nature, combined with its high sensitivity and specificity, make it an ideal first-line diagnostic technique for patients presenting with palpable masses in the head and neck region. Furthermore, the findings of this study support the continued use of FNAC in clinical practice,

particularly for the early detection of malignancies in high-risk patients [13].

The study's large sample size (500 patients) and the three-year study period lend strength to its conclusions. However, there are limitations to consider, including the retrospective nature of the study and the potential for sampling errors inherent in FNAC procedures. Future studies should aim to address these limitations by prospectively evaluating FNAC in a larger, more diverse patient population.

CONCLUSION

FNAC is a highly effective diagnostic tool for evaluating head and neck lesions. Its high diagnostic accuracy, combined with its minimally invasive nature, makes it an essential component of the diagnostic workup for patients with palpable masses in the head and neck region. The findings of this study underscore the importance of continued utilization of FNAC in clinical practice, particularly for the early detection and management of malignancies. Histopathological correlation is recommended in cases where clinical suspicion remains high, despite negative FNAC results, to ensure optimal patient outcomes.

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