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Original Article

Cytological Evaluation of Salivary Gland Swelling with Histopathological Correlation

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ABSTRACT

Background: Salivary gland swellings comprise a wide spectrum of non-neoplastic, benign, and malignant lesions. Fine Needle Aspiration Cytology (FNAC) is widely used as a minimally invasive, cost-effective tool for preliminary evaluation, but its diagnostic accuracy varies among different lesions. ***Aim*****:** To evaluate cytological features of salivary gland swellings and assess the diagnostic accuracy of FNAC by correlating cytological findings with histopathological diagnoses. ***Methods*****:** Sixty cases of salivary gland swellings were subjected to FNAC, and diagnoses were categorized as non-neoplastic, benign, or malignant. All cases underwent subsequent histopathological examination. Diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated. ***Results*****:** The majority of cases occurred in the 41–60-year age group. Benign neoplasms (46.6%) were the most common cytological diagnosis, followed by non-neoplastic lesions (41.6%) and malignant tumors (11.6%). Overall cytology–histopathology concordance was 91.2%. FNAC demonstrated a sensitivity of 90.3%, specificity of 96.1%, PPV of 94.5%, and NPV of 92.3%. Diagnostic discrepancies occurred mainly in low-grade malignancies and cystic or paucicellular lesions. ***Conclusion*****:** FNAC is a reliable, minimally invasive diagnostic method for salivary gland swellings with high accuracy, especially in benign lesions. While histopathology remains the gold standard, FNAC significantly contributes to early diagnosis and clinical decision-making.

Keywords*:* Salivary gland cytology.

INTRODUCTION

Salivary gland swellings represent a diverse group of lesions ranging from non-neoplastic inflammatory conditions to benign and malignant neoplasms. Their heterogeneous clinical presentation often makes clinical diagnosis alone insufficient for definitive characterization. Fine Needle Aspiration Cytology (FNAC) has emerged as a widely used, minimally invasive diagnostic tool for evaluating salivary gland lesions due to its simplicity, cost-effectiveness, and rapid turnaround time[1]. FNAC provides valuable preoperative information that guides clinical decision-making, helps differentiate surgical from conservative management, and reduces unnecessary procedures[2].

The parotid gland is the most commonly involved site, followed by the submandibular and minor salivary glands[3]. Epidemiological studies show that benign tumors, particularly pleomorphic adenoma, constitute the majority of salivary gland neoplasms[4]. Malignancies such as mucoepidermoid carcinoma and adenoid cystic carcinoma account for a smaller yet clinically significant proportion, requiring accurate identification due to their variable prognosis[5]. However, the cytological distinction between benign and low-grade malignant tumors may be challenging in certain cases, especially in lesions with cystic change or low cellularity. Histopathology remains the gold standard for final diagnosis. Thus, correlating FNAC findings with histopathological outcomes is essential to determine the accuracy and limitations of FNAC in routine practice[7]. Several studies have reported a wide range of diagnostic accuracy for FNAC in salivary gland swellings, generally ranging between 80–95%, depending on tumor subtype and sampling adequacy[8]. Despite its limitations, FNAC

continues to be a frontline investigation owing to its high specificity and ability to reliably differentiate neoplastic from non-neoplastic lesions[9].
Given the diagnostic variability across populations and institutional settings, it is important to evaluate FNAC performance in local contexts. This study aims to assess the cytological patterns of salivary gland swellings and analyze their correlation with histopathological diagnoses, thereby determining the diagnostic accuracy of FNAC in distinguishing various salivary gland lesions.

Objectives

1. To categorize salivary gland swellings based on cytological diagnosis into non-neoplastic, benign, and malignant lesions.
2. To correlate FNAC findings with corresponding histopathological diagnoses to assess concordance.
3. To determine the diagnostic performance of FNAC by calculating sensitivity, specificity, positive predictive value, and negative predictive value.

METHODOLOGY

This was a prospective observational study conducted in the Department of Pathology of a tertiary care teaching hospital. The study included patients presenting with salivary gland swellings who underwent FNAC followed by histopathological examination. A total of 60 patients with clinically evident salivary gland swellings were included. Patients of all age groups and both genders were recruited consecutively during the study period.

Inclusion Criteria

- Patients presenting with palpable salivary gland swelling.
- Patients who underwent FNAC followed by surgical excision or biopsy for histopathological correlation.
- Adequate cytological material obtained for interpretation.

Exclusion Criteria

- Patients with recurrent salivary gland lesions.
- Inadequate or unsatisfactory FNAC samples.
- Patients who did not undergo subsequent histopathological evaluation.

Procedure for FNAC-Fine Needle Aspiration Cytology was performed using a 22–24-gauge needle attached to a 10 mL syringe under aseptic precautions. Multiple passes were taken when required to ensure adequate material. Both air-dried and 95% ethanol-fixed smears were prepared.

1. Air-dried smears were stained with Giemsa stain.
2. Alcohol-fixed smears were stained using Papanicolaou stain.

Smears were evaluated for cellularity, architectural patterns, nuclear features, and background characteristics.

All FNAC-diagnosed cases underwent surgical excision or biopsy. Tissue specimens were fixed in 10% neutral buffered formalin, processed routinely, embedded in paraffin, and stained with Hematoxylin and Eosin (H&E). Histopathological diagnosis served as the gold standard for confirmation.
FNAC diagnoses were categorized into:

1. **Non-neoplastic lesions**
2. **Benign neoplasms**
3. **Malignant neoplasms**

These were compared with corresponding histopathological diagnoses to determine concordance. The study was conducted in accordance with institutional ethical guidelines. Confidentiality of patient data was maintained, and informed consent was obtained prior to FNAC.

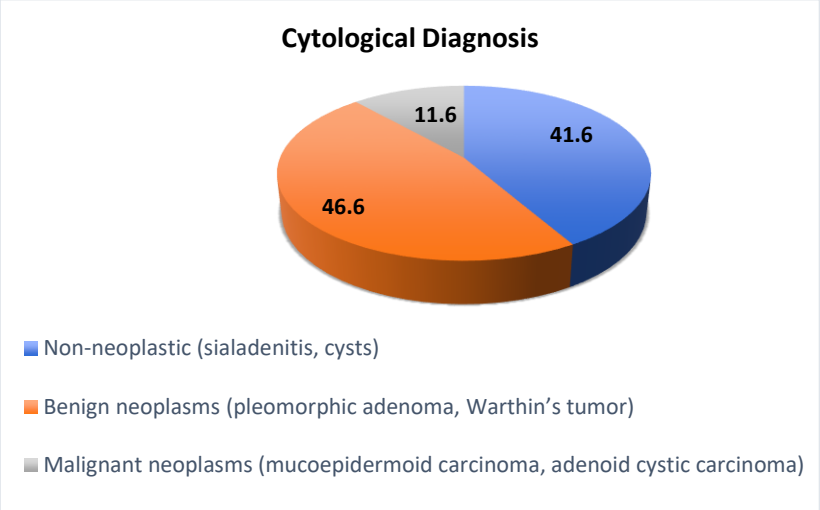
Results and Observations

Table 1: Distribution of Cases According to Age and Sex

Age Group (years)	Male	Female	Total
0–20	3 (10%)	2 (6.6%)	5 (8.3%)
21–40	8 (26.6%)	6 (20%)	14 (23.3%)
41–60	10 (33.3%)	12 (40%)	22 (36.6%)
>60	9 (30%)	10 (33.3%)	19 (31.6%)
Total	30	30	60

The age and sex distribution is presented in Table 1. The majority of cases occurred in the 41–60 years age group, accounting for 36.6% of all patients, followed by the >60 years group (31.6%). Younger patients aged 0–20 years constituted only 8.3% of the study population. The study included equal numbers of males and females (30 each). Across all age categories, a relatively balanced sex distribution was noted, with a slight female predominance in the older age groups (41–60 years and >60 years).

Chart No.1-Distribution of Cytological Diagnosis-



The cytological spectrum of salivary gland swellings is shown in Chart 1. Benign neoplasms formed the largest diagnostic category (46.6%, n = 28), with pleomorphic adenoma being the most common entity. Non-neoplastic lesions, including sialadenitis and cysts, constituted 41.6% (n = 25). Malignant neoplasms accounted for 11.6% (n = 7), predominantly mucoepidermoid carcinoma and adenoid cystic carcinoma. Thus, benign and non-neoplastic lesions collectively comprised nearly 90% of all swellings, reflecting the typical distribution pattern of salivary gland pathology.

Table 2: Cytological and Histopathological Correlation

Cytological Diagnosis	Histopathological Diagnosis	Concordant Cases	Diagnostic Accuracy (%)
Pleomorphic adenoma	Pleomorphic adenoma	26/28	92.8
Warthin's tumor	Warthin's tumor	6/6	100
Mucoepidermoid carcinoma	Mucoepidermoid carcinoma	5/6	83.3
Chronic sialadenitis	Chronic sialadenitis	22/25	88
Overall Concordance	-	-	91.2

The correlation between FNAC diagnoses and histopathological findings is summarized in Table 2. Pleomorphic adenoma demonstrated high concordance, with 26 out of 28 cases confirming the diagnosis histologically (92.8% accuracy). Warthin's tumour showed 100% diagnostic accuracy, while chronic sialadenitis demonstrated 88% correlation (22/25 cases). Among malignant lesions, mucoepidermoid carcinoma exhibited 83.3% accuracy (5/6 cases). The overall diagnostic concordance of FNAC with histopathology was 91.2%, indicating strong reliability of FNAC as a primary diagnostic tool.

Table 3: Diagnostic Performance of FNAC Compared to Histopathology

Category	True Positive	True Negative	False Positive	False Negative
Benign lesions	28	25	1	2
Malignant lesions	6	50	1	3

Sensitivity = 90.3%, Specificity = 96.1%, Positive Predictive Value = 94.5%, Negative Predictive Value = 92.3%.The diagnostic performance of FNAC compared to histopathology is presented in Table 3. For benign lesions, FNAC identified 28 true positives and 25 true negatives, with 1 false positive and 2 false negatives. In malignant lesions, FNAC yielded 6 true positives, 50 true negatives, 1 false positive, and 3 false negatives.

These findings confirm that FNAC possesses high diagnostic accuracy, particularly for distinguishing benign from malignant salivary gland lesions.

Table 4: Distribution of Discordant (False Positive/False Negative) Cases

Lesion Type	False Positive (FP)	False Negative (FN)	Common Cause of Error
Benign lesions	1	2	Overlapping cytomorphology, cystic degeneration
Malignant lesions	1	3	Low-grade features mimicking benign lesions
Non-neoplastic lesions	–	2	Sampling error; paucicellular smears
Overall	2	5	–

Table 4 shows that most diagnostic errors in FNAC were false negatives (5 cases), mainly due to low-grade malignant tumors and paucicellular or cystic samples that made accurate cytological interpretation difficult. False positives were rare (2 cases) and usually resulted from reactive atypia mimicking neoplasia. Overall, the pattern indicates that FNAC is highly reliable, with errors occurring mainly in lesions with subtle cytological features or inadequate sampling.

DISCUSSION

Salivary gland swellings constitute a heterogeneous group of lesions with a broad clinical spectrum, making accurate diagnosis essential for appropriate management. In this study, FNAC proved to be a highly valuable initial diagnostic tool for evaluating salivary gland lesions. The age distribution in our findings, with a predominance in the 41–60-year age group, aligns with the epidemiological pattern described in earlier literature, where salivary gland tumors commonly affect middle-aged individuals[3]. The nearly equal sex distribution observed also reflects trends reported from population-based studies[4]. The cytological spectrum in the present study demonstrated benign neoplasms as the most frequent category, followed by non-neoplastic and malignant lesions. This pattern is consistent with existing reports indicating pleomorphic adenoma as the most common salivary gland tumor[4] and mucoepidermoid carcinoma as the most frequent malignancy[5]. FNAC provided a reliable classification in the majority of cases, reaffirming its established role in preoperative evaluation[1]. However, diagnostic challenges occurred mainly in cystic or low-grade malignant tumors, which is a known limitation of FNAC due to subtle atypia or scant cellularity[6].Correlation with histopathology, the gold standard for definitive diagnosis[7], revealed an overall diagnostic accuracy of 91.2%. This falls within the accuracy range of 80–95% reported in numerous reviews[8]. Pleomorphic adenoma and Warthin's tumor showed high concordance rates, supporting prior findings that FNAC performs excellently in diagnosing common benign tumors[1]. Conversely, the lower accuracy in mucoepidermoid carcinoma highlights the difficulty of distinguishing low-grade malignancies from benign lesions, a challenge previously documented in the literature[9].The false-negative cases in the current study were largely attributable to inadequate sampling, cystic degeneration, or bland cytological features, similar to observations by Zbären et al.[6]. False positives were few, likely resulting from reactive atypia or metaplastic changes mimicking neoplasia, as previously reported in diagnostic reviews[2]. The high specificity (96.1%) and positive predictive value reinforce the reliability of FNAC in ruling in neoplastic lesions, whereas false-negative cases emphasize the importance of correlating clinical, radiological, and cytological findings.

Overall, this study supports the utility of FNAC as a rapid, minimally invasive, and cost-effective tool for initial evaluation of salivary gland swellings. Despite inherent limitations, especially in low-grade malignancies, FNAC continues to be an indispensable component of diagnostic workup when interpreted with clinical and radiological context. Histopathological confirmation remains essential for definitive diagnosis and treatment planning[7].

CONCLUSION

The present study demonstrates that Fine Needle Aspiration Cytology (FNAC) is a highly effective and reliable diagnostic tool for evaluating salivary gland swellings. FNAC showed excellent diagnostic accuracy, particularly for benign neoplasms such as pleomorphic adenoma and Warthin's tumor, and maintained high specificity in differentiating neoplastic from non-neoplastic lesions. Although challenges were noted in diagnosing low-grade malignant and cystic lesions, overall concordance with histopathology remained strong. The high sensitivity, specificity, and predictive values observed reaffirm FNAC as an essential first-line investigation due to its minimally invasive nature, rapid results, and cost-effectiveness. Histopathology continues to remain the gold standard, but FNAC significantly contributes to early diagnosis, appropriate clinical decision-making, and reduction of unnecessary surgical procedures. Continued refinement in sampling techniques and combined clinical-radiological correlation can further enhance diagnostic accuracy in salivary gland pathology.

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