Section: Pathology

Original Research Article

CYTOMORPHOLOGICAL EVALUATION OF MAJOR SALIVARY GLAND LESIONS BY FINE NEEDLE ASPIRATION CYTOLOGY: A PROSPECTIVE STUDY WITH CYTO-HISTOPATHOLOGICAL CORRELATION

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ABSTRACT

Background: Salivary gland lesions comprise a diverse spectrum of inflammatory, benign, and malignant conditions that often present diagnostic challenges. Fine Needle Aspiration Cytology (FNAC) serves as a rapid, minimally invasive, and cost-effective technique for evaluating these lesions and guiding clinical management. The objective is to analyze the cytomorphological features of major salivary gland lesions, determine their distribution, and correlate FNAC findings with available histopathological diagnoses.

Materials and Methods: This prospective study included 109 patients presenting with major salivary gland swellings over an 18-month period. FNAC was performed using standard techniques, and smears were stained with Giemsa, Papanicolaou, and H&E stains. Ultrasound-guided aspiration was used for deep-seated lesions. Cytological diagnoses were categorized as non-neoplastic or neoplastic. Histopathological correlation was available in 11 cases and used to assess diagnostic accuracy.

Results: The parotid gland was the most frequently involved site (69%). Non-neoplastic lesions comprised 32% of cases, with chronic sialadenitis being the most common (51%). Neoplastic lesions accounted for 68% of cases, of which 88% were benign. Pleomorphic adenoma was the most common benign tumor (85%), while mucoepidermoid carcinoma was the predominant malignant neoplasm (78%). Cyto-histological concordance was observed in 7 of 11 cases, with high accuracy for mucoepidermoid carcinoma and pleomorphic adenoma.

Conclusion: FNAC is a valuable and reliable first-line diagnostic tool for assessing salivary gland lesions. It effectively differentiates inflammatory, benign, and malignant conditions and demonstrates good correlation with histopathology. Despite occasional diagnostic challenges due to overlapping cytomorphological features, FNAC remains indispensable in the preliminary evaluation and management of salivary gland pathology.

Keywords: Fine Needle Aspiration Cytology (FNAC); Salivary gland lesions; Pleomorphic adenoma; Mucoepidermoid carcinoma; Cytomorphology; Histopathological correlation; Parotid gland.

INTRODUCTION

Salivary gland lesions encompass a wide spectrum of inflammatory, non-neoplastic, and neoplastic conditions, each presenting with diverse clinical and morphological features that often overlap and pose diagnostic challenges. The major salivary glands—parotid, submandibular, and sublingual—are affected most frequently, with the parotid gland accounting for nearly 70% of all salivary gland swellings.[1] Although most lesions are benign, the potential for

malignancy requires early and accurate diagnosis to guide appropriate therapeutic decisions.

Fine Needle Aspiration Cytology (FNAC) has emerged as a valuable, minimally invasive, cost-effective, and rapid diagnostic technique for evaluating salivary gland masses. Its utility lies in its ability to differentiate between inflammatory, benign, and malignant lesions, and in many cases, to provide a specific diagnosis that assists surgeons in planning optimal treatment strategies.[2-4] FNAC offers significant advantages, including minimal patient discomfort, absence of major complications, and the ability to sample deeper lesions using ultrasound guidance when required.[5] Despite these strengths, the cytological diagnosis of salivary gland lesions can sometimes be difficult due to their complex histogenesis, diverse architectural patterns, the presence of myoepithelial cells, cystic changes, and overlapping features between benign and malignant tumors.[6]

Several studies have demonstrated high diagnostic accuracy of FNAC in salivary gland lesions, with sensitivity and specificity varying widely depending on tumor type and the expertise of the cytopathologist.[7-9] Pleomorphic adenoma remains the most common benign salivary gland tumor, while mucoepidermoid carcinoma constitutes the majority of malignant neoplasms. Inflammatory lesions, such as sialadenitis, also contribute significantly to salivary gland pathology. Given the heterogeneity of these lesions and the clinical importance of accurate preoperative diagnosis, continuous evaluation of FNAC performance across different institutions is essential.

In this context, the present study aims to analyze the cytomorphological spectrum of major salivary gland lesions, correlate cytological diagnoses with available histopathological findings, and assess the diagnostic utility and accuracy of FNAC in a tertiary care setting. By examining 109 cases over a defined study period, this study contributes valuable insights into the effectiveness and limitations of FNAC in routine clinical practice for salivary gland evaluation.

MATERIALS AND METHODS

This prospective study titled "Fine Needle Aspiration Cytology of Major Salivary Gland Lesions" was conducted in the Department of Pathology, JJM Medical College, Davangere, over a period of 18 months from March 2021 to August 2022. All patients presenting with swellings of the major salivary glands—parotid, submandibular, or sublingual—who were referred to the department for FNAC during the study period were included. A total of 109 patients formed the study sample. Patients with bleeding diathesis and those who were non-cooperative were excluded. After obtaining informed consent, a detailed clinical examination was performed for each patient. FNAC was carried out under strict aseptic precautions using a 22–23 gauge, 30–40 mm needle attached to a 5 ml syringe. The lesion was stabilized with the fingers, and negative pressure was applied to obtain the aspirate. For deep-seated or non-palpable lesions, ultrasound-guided FNAC was performed by radiologists. Both air-dried and alcohol-fixed smears were prepared; air-dried smears were stained with Giemsa stain, whereas alcohol-fixed smears were stained using Papanicolaou stain and Hematoxylin and Eosin (H&E). Ziehl–Neelsen staining was performed when clinically indicated.

Cystic lesions were completely aspirated, and residual palpable masses were re-aspirated to ensure adequate sampling. Each patient was observed for 15–20 minutes post-procedure for immediate complications. Out of the 109 cases, 11 patients subsequently underwent surgical excision based on clinical indications. The excised specimens were fixed in 10% formalin for 24–48 hours, routinely processed, and stained with H&E. Histopathological findings were independently evaluated and compared with cytological diagnoses for cyto-histopathological correlation. The nature of the aspirate, smear adequacy, cellular morphology, and background features were analyzed in all cases. The diagnostic utility of FNAC was assessed by correlating cytological diagnoses with available histopathology, thereby determining accuracy and identifying potential pitfalls.

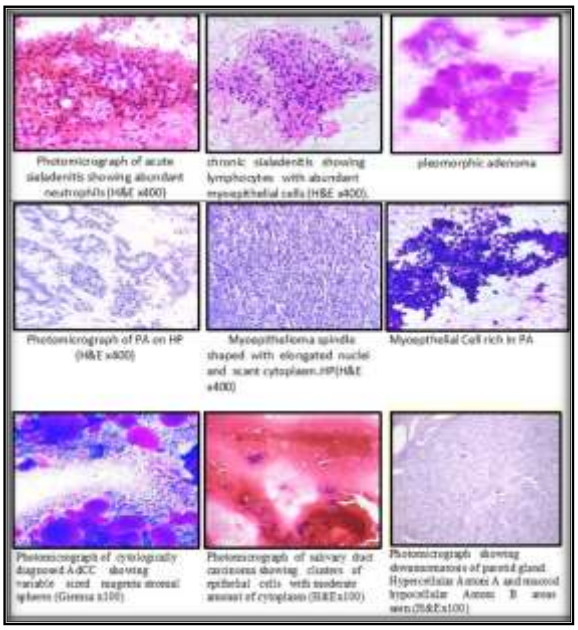

Figure 1: Histological Slides

RESULTS

The present study included a total of 109 patients with major salivary gland lesions, with ages ranging from 11 to 80 years and the highest proportion belonging to the 31–40-year age group (31.2%), followed by 21–30 years (18.3%) and 51–60 years (15.6%). A slight female predominance was observed, with 58 females (53.2%) and 51 males

(46.8%). The parotid gland was the most commonly affected site, accounting for 75 cases (68.8%), while the submandibular gland was involved in 34 cases (31.2%). Regarding the nature of aspirates obtained during FNAC, the majority were hemorrhagic (96 cases; 88.1%), followed by grey-white aspirates (4.6%), blood-tinged material (2.8%), and a small number of mucoid, purulent, gelatinous, necrotic, and oily aspirates, each constituting 0.9% of the samples. This demographic and clinical profile highlights the predominant involvement of the parotid gland and the high frequency of hemorrhagic aspirates in salivary gland FNAC procedures.

The site distribution of major salivary gland lesions in the present study showed that the parotid gland was the most frequently involved site, accounting for 75 cases (69%), with 46 lesions on the right side and 29 on the left. The submandibular gland constituted the remaining 34 cases (31%), of which 22 were located on the right side and 12 on the left. This pattern highlights the clear predominance of parotid gland involvement compared to the submandibular gland, with a slight right-sided predominance observed for both glands.

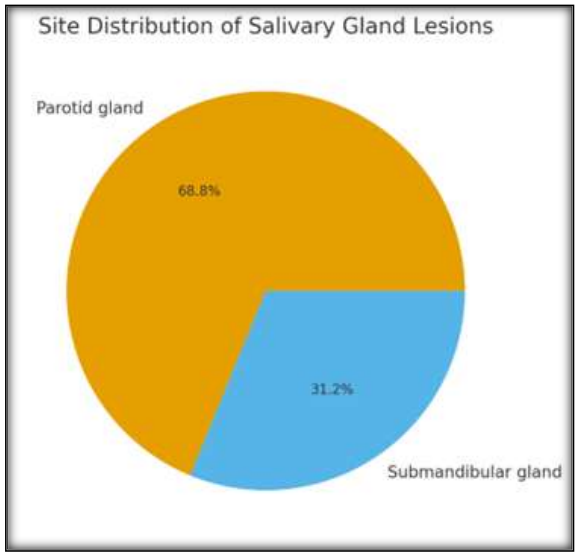

Figure 2: Site Distribution.

Table 1: Demographic Profile of Study Participants (N = 109)

Variable	Category	Number (n)	Percentage (%)
Age Group (years)	11–20	8	7.3
	21–30	20	18.3
	31–40	34	31.2
	41–50	13	11.9
	51–60	17	15.6
	61–70	15	13.8
	71–80	2	1.8
Gender	Male	51	46.8
	Female	58	53.2
Site of Lesion	Parotid gland	75	68.8
	Submandibular gland	34	31.2
Aspirate Characteristics	Hemorrhagic	96	88.1
	Grey-white	5	4.6
	Blood-tinged	3	2.8
	Mucoid	1	0.9
	Purulent	1	0.9
	Gelatinous	1	0.9
	Necrotic	1	0.9
	Oily	1	0.9

Table 2: Nature of Aspirate

Type	No. of Cases	%
Hemorrhagic	96	88%
Grey white	5	4%
Blood tinged	3	3%
Mucoid/Purulent/Gelatinous/Necrotic/Oily	1 each	1%

The analysis of aspirate characteristics revealed that hemorrhagic aspirates were overwhelmingly the most common, observed in 96 cases (88%), indicating the highly vascular nature of most salivary gland lesions. Grey-white aspirates accounted for 5 cases (4%), while blood-tinged aspirates were seen in 3 cases (3%). Less commonly encountered were mucoid, purulent, gelatinous, necrotic, and oily aspirates, each noted in a single case (1%). This distribution reflects the predominance of hemorrhagic aspirates in FNAC of major salivary gland lesions, with other aspirate types occurring rarely.

The lesions evaluated in the present study were broadly classified into non-neoplastic and neoplastic categories. Non-neoplastic lesions accounted for 35 cases (32%), reflecting various inflammatory and reactive conditions of the major salivary glands. In contrast, neoplastic lesions constituted the majority, with 74 cases (68%), indicating that most patients presenting with salivary gland swellings had underlying neoplastic pathology. This distribution highlights the significant proportion of tumor-related lesions among salivary gland aspirates and underscores the importance of FNAC in their early identification and differentiation.

Among the 35 non-neoplastic lesions identified in the present study, chronic sialadenitis was the most common diagnosis, accounting for 18 cases (51%), followed by acute sialadenitis in 7 cases (20%). Acute on chronic sialadenitis was noted in 2 cases (6%), while sialadenosis constituted 6 cases (17%), reflecting its relevance as a non-inflammatory, non-neoplastic glandular enlargement. Additionally, there was one case each (3% each) of non-diagnostic aspirate and benign cystic lesion. This distribution highlights that inflammatory conditions, particularly chronic sialadenitis, form the bulk of non-neoplastic salivary gland lesions encountered on FNAC.

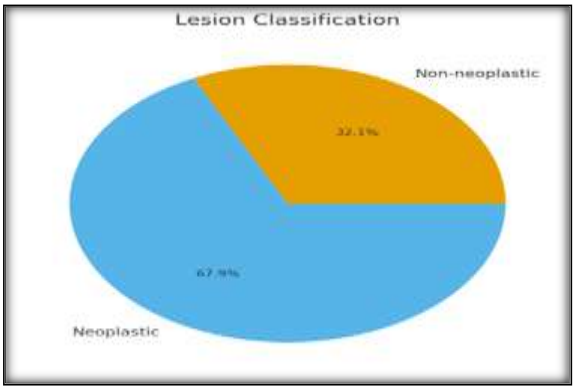

Figure 3. Lesion Classification.

Table 3: Non-Neoplastic Lesions

Diagnosis	No. of Cases	%
Chronic sialadenitis	18	51%
Acute sialadenitis	7	20%
Acute on chronic sialadenitis	2	6%
Sialadenosis	6	17%
Non-diagnostic	1	3%
Benign cystic lesion	1	3%

Table 4: Distribution of Neoplasms

Type	No.	% (of benign)	Type	No.	% (of malignant)
Pleomorphic adenoma	55	85%	Mucoepidermoid carcinoma	7	78%
Warthin's tumor	9	14%	Adenoid cystic carcinoma	1	11%
Myoepithelial-cell-rich neoplasm	1	1%	Salivary duct carcinoma	1	11%

Among the neoplastic lesions diagnosed in the present study, benign neoplasms predominated, with pleomorphic adenoma being the most common, accounting for 55 cases (85% of benign tumors), followed by Warthin's tumor in 9 cases (14%) and a single case of myoepithelial-cell-rich neoplasm (1%). Among malignant neoplasms, mucoepidermoid carcinoma was the most frequently encountered tumor, comprising 7 cases (78% of malignant lesions), while adenoid cystic carcinoma and salivary duct carcinoma were identified in 1 case each (11% each). This distribution reflects the characteristic predominance of pleomorphic adenoma among benign tumors and mucoepidermoid carcinoma among malignant tumors of the major salivary glands.

Table 5: Cyto-Histological Correlation (n = 11)

Cytological Diagnosis	Histopathological Outcome	Concordant Cases
Pleomorphic adenoma	4 confirmed; 2 reclassified as Warthin's tumor	4
Warthin's tumor	1 reclassified as myoepithelioma	–
Mucoepidermoid carcinoma	3 confirmed (2 high-grade, 1 low-grade)	3
Myoepithelial-cell-rich neoplasm	Schwannomatosis	–

Cyto-histological correlation was available for 11 cases in the present study, allowing assessment of FNAC diagnostic accuracy. Among six cases cytologically diagnosed as pleomorphic adenoma, four were confirmed on histopathology, while two were reclassified as Warthin's tumor, yielding four concordant cases. The single case diagnosed as Warthin's tumor on cytology was later identified as myoepithelioma on histopathology, showing no concordance. All three cases reported as mucoepidermoid carcinoma on FNAC were confirmed on histopathology, including two high-grade and one low-grade tumor, demonstrating complete concordance in this group. The case labeled as myoepithelial-cell-rich neoplasm on cytology was diagnosed as schwannomatosis on histopathology, resulting in no concordance. Overall, FNAC showed reliable correlation with histopathology in most cases, particularly for mucoepidermoid carcinoma and pleomorphic adenoma.

DISCUSSION

Fine needle aspiration cytology (FNAC) is widely recognized as an effective, minimally invasive diagnostic modality for evaluating salivary gland lesions, particularly due to its ability to rapidly distinguish between non-neoplastic, benign, and malignant conditions. Several studies have highlighted FNAC as a valuable first-line investigation in salivary gland pathology because of its simplicity, safety, and diagnostic utility, especially when combined with clinical and radiologic correlation.[10,11] The present study assessed the cytomorphological spectrum of major salivary gland

lesions and correlated FNAC findings with available histopathology to determine diagnostic accuracy.

In our study, salivary gland swellings were most commonly encountered in the parotid gland, followed by the submandibular gland, consistent with findings reported by Jayaram et al,[10] and Naz et al,[11] who observed similar gland involvement patterns. The age distribution in our cases (11–80 years) also mirrored previous studies, such as those by Stewart et al,[12] and Jain et al,[13] which documented that salivary gland lesions typically present in a wide age range with peak incidence in the third to fifth decades. Comparable demographic characteristics have also been noted by Costas et al,[14] and Allison et al,[15] reinforcing the broad clinical spectrum of these lesions. A slight female predominance observed in our series aligns with data presented by Das et al,[16] although some studies have reported male predominance depending on population characteristics.

Non-neoplastic lesions formed a significant proportion of cases in the present study, with chronic sialadenitis being the most common. Similar observations were made by Rajwanshi et al,[17] and Singh Nanda et al,[18] who emphasized that inflammatory lesions constitute a considerable diagnostic subset in FNAC practice. FNAC features—including lymphocytic infiltration, ductal epithelial cells, and a hemorrhagic background—were consistent with those described in previous studies. However, diagnostic challenges may arise in cystic or low-yield aspirates, a limitation also discussed by Naz et al,[11] and Jayaram et al.[10]

Among neoplastic lesions, pleomorphic adenoma emerged as the predominant benign tumor, a finding in agreement with multiple reports, including those by Satarkar et al,[24] and Raval et al.[25] The cytological presentation—comprising both epithelial and myoepithelial components within a fibrillary or chondromyxoid stroma—correlates with classical diagnostic criteria highlighted in earlier works by Jain et al,[13] and Stewart et al.[12] Warthin's tumor was the second most common benign neoplasm, and its detection exclusively in the parotid gland is consistent with observations made by Costas et al,[14] who emphasized its strong site predilection.

In our series, mucoepidermoid carcinoma (MEC) was the most frequent malignant tumor identified, correlating with findings from Naz et al,[11] and Das et al,[16] who similarly reported MEC as a common salivary gland malignancy. The presence of mucin-secreting, intermediate, and squamoid cells in varying proportions facilitated accurate cytologic diagnosis, although low-grade tumors may occasionally pose interpretational challenges. As highlighted by Allison et al,[15] cystic degeneration, scant cellularity, or overlapping features with benign cystic lesions can limit FNAC accuracy in such cases. Cyto-histological correlation in our study showed concordance in most cases, particularly for MEC and pleomorphic adenoma. However, discrepancies were noted between pleomorphic adenoma and Warthin's tumor—an issue frequently reported in the literature due to overlapping oncocytic or metaplastic changes. The diagnostic pitfalls emphasized by Rajwanshi et al,[17] and Singh Nanda et al,[18] reflect similar challenges encountered in our analysis. These limitations underscore the importance of integrating FNAC findings with clinical and imaging data for optimal diagnostic accuracy.

Overall, the findings of this study reaffirm the significant diagnostic role of FNAC in salivary gland lesions. Although certain limitations persist—especially with cystic lesions and tumors exhibiting morphological overlap—FNAC remains a reliable, cost-effective tool with substantial clinical utility, as consistently supported by the literature from through.[10,25]

CONCLUSION

Fine Needle Aspiration Cytology (FNAC) is a highly valuable, minimally invasive, and reliable diagnostic tool for the evaluation of major salivary gland lesions. In the present study, FNAC demonstrated excellent utility in differentiating non-neoplastic, benign, and malignant conditions, with pleomorphic adenoma being the most common benign tumor and mucoepidermoid carcinoma the most frequent malignant lesion. Cyto-histological correlation, available in a subset of cases, showed good concordance, particularly for malignant tumors, reaffirming the diagnostic accuracy of FNAC. Although certain lesions posed challenges due to overlapping cytomorphological features and tumor heterogeneity, FNAC remained an essential preliminary investigative modality that effectively guided clinical management. Histopathological examination continues to serve as the definitive diagnostic standard in doubtful or discordant cases. Overall, this study highlights the significant role of FNAC as a first-line diagnostic approach in salivary gland pathology and emphasizes the need for careful interpretation supported by clinical and radiological correlation whenever necessary.

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