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Original Research Article

Assessing Diagnostic Accuracy of FNAC of Parotid Gland to Determine its Usefulness in the Planning Surgery

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Abstract

Aim: The aim of the present investigation was to assess the diagnostic accuracy of FNAC, on parotid gland swellings, in order to determine its usefulness in the planning of parotid gland surgery.

Methods: The Pathology Department performed this 2-year investigation with 50 patients. All patients had US-guided FNAC after clinical assessment. Only Institute-performed FNAC was examined for uniform and comparable data. A computerized database stored demographic and clinical data, including age, sex, prior surgery, timing of symptoms, cytological and histological findings, lesion location and volume, histological sample margin involvement, and relapses.

Results: FNAC was taken in 50 instances. FNAC indicated "non-diagnostic" in 12 (24%), "inflammatory/beneficial lesion" in 33 (66%), and "malignant neoplasm" in 5 (10%). Pleomorphic adenoma was found in 22 individuals (55%) and Warthin's tumor in 20 (20%). Adenocarcinoma (5%) and Mucoepidermoid carcinoma (2.50%) were the most frequent cancers. The most prevalent histological diagnosis was "benign lesion" in 35 individuals. FNAC has 82% sensitivity and 98% specificity. Overall diagnosis accuracy was 97%, with 96% accuracy for malignancy and 82% for benign lesions. FNAC malignancies PPV and NPV were 92% and 97%, respectively. The probability ratio of positive test findings was 100.3 and negative test results was 0.17, where "positive" indicated "malignant". 0.112 percent had cancer.

Conclusion: Our research demonstrates that preoperative FNAC aids parotid tumor diagnosis. It diagnoses and treats parotid cancers safely and effectively. Fine needle aspiration cytology is safe, cost-effective, and simple.

Keywords: Salivary glands, Parotid, FNAC, Cytology.

Introduction

Salivary gland tumors are uncommon growths, occurring in around 2.5-3 instances per 100,000 people, and accounting for approximately 3% of all tumors in the head and neck region. The majority of salivary gland tumors occur in the parotid gland, accounting for around 75-80% of cases. Only 20% of these tumors are classified as malignant. [1,2] The etiology of salivary gland tumors is a subject of ongoing controversy. It is hypothesized that smoking, viral infections, and genetic predisposition may all contribute significantly to their development. Ionizing radiation is the only recognized risk factor that has been confirmed to have a role in the development of malignant cancers. [3,4]

The first preoperative assessment of salivary gland tumors involves obtaining the patient's medical history, followed by a comprehensive clinical examination of the face and neck. This is supplemented with imaging studies, including ultrasonography and computed tomography, as well as fine-needle aspiration cytology (FNAC). FNAC is a favored modality for acquiring morphological diagnostic prior to surgery. Due to its affordability, little invasiveness, and capacity for preoperative diagnosis, this approach is favored for diagnostic purposes. FNAC is very efficient in promptly evaluating the physical characteristics of lesions, giving vital insights into the source (salivary or non-salivary), type (benign or malignant), and/or severity (low or high grade) of the malignancies. The information collected in this manner is very important for guiding appropriate clinical and surgical treatment. [5,6] While cytology is generally reliable, it may not always be sufficient for a conclusive diagnosis in some circumstances when histological diagnosis is considered the most

accurate method. FNAC has limitations, particularly in the identification of uncommon entities and differentiation of lesions with similar cytological characteristics, which is often seen in salivary gland malignancies. [7]

Salivary gland epithelial tumors are categorized by the World Health Organization into 10 benign and 23 malignant types. Non-epithelial neoplasms are uncommon, accounting for around 2-5% of all malignancies in the salivary glands. This intricate categorization is based on histological characteristics and offers the benefit of predicting the prognosis and treatment results by considering the distinct behavior of each kind of tumor. The extensive heterogeneity of these tumors is associated with the presence of many cell types inside salivary glands, including ductal, acinar, myoepithelial, and basal cell types. [8] The wide range of different kinds, however, also makes FNAC diagnosis a difficult process. The objective of this study was to evaluate the diagnostic precision of FNAC (Fine Needle Aspiration Cytology) in diagnosing parotid gland swellings, with the purpose of determining its use in guiding parotid gland surgery.

Methods

The current investigation was carried out at the Department of Pathology, including a cohort of 50 patients over a span of 2 years.

Every patient received fine-needle aspiration cytology (FNAC) with the assistance of ultrasound (US) guidance after a clinical examination. Only FNAC procedures conducted inside the Institute were taken into account to ensure the data was consistent and could be compared. All demographic and clinical information, such as age, gender, prior surgeries, symptom onset, cytological and histological findings, location and size of the lesions, involvement of histological sample margins, and occurrences of recurrence, were recorded in an electronic database. At our hospital, Fine Needle Aspiration Cytology (FNAC) is consistently conducted by radiologists using ultrasound guidance.

Every patient undergoes cytology examination by the same pathologist. At our facility, FNAC was conducted as part of the preoperative evaluation for all patients. The procedure was conducted at our pathology department using a conventional method. A 22-gauge needle was connected to a 10ml syringe using a manual procedure. In order to provide sufficient biological material for cytological analysis, a minimum of two passes were performed in each instance. The aspirated material was evenly distributed over 2 to 4 slides and promptly repaired. The slides were stained using both the Papanicolaou and May-Grunwald Giemsa techniques. Using the final histopathology as the definitive standard, we categorized our FNAC results into the following groups: true-negative (correctly diagnosed absence of malignancy), true-positive (correctly diagnosed presence of malignancy), false-negative (failed to diagnose a malignancy based on cytological specimen), and false-positive (incorrectly considered a cytological specimen as malignant). We conducted a comparison between the histopathology of the surgical specimen at the end and the preoperative cytology of the FNAC specimen. We assessed the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of FNAC in distinguishing between benign and malignant diseases using the Galen and Gambino method.

A statistical analysis was performed using SPSS version 22. Kappa statistics for agreement were also calculated together with the 95% confidence interval (95% CI).

Results

Table 1: The FNAC results classification

Diagnosis	FNAC no. (%)	Histology no. (%)
Benign/Inflammatory lesions	33 (66%)	35 (70%)
Malignant tumours	5 (10%)	6 (12%)
Non-Diagnostic	12 (24%)	5 (10%) benign lesions, 4 (8%) malignant tumours

FNAC samples were obtained in 50 cases. FNAC results were “non-diagnostic” in 12 cases (24%), “inflammatory/ benign lesion” in 33 (66%), “malignant neoplasm” in 5 (10%).

Table 2: Cytodiagnosis of salivary gland tumours by aspiration biopsy

Lesion	N	%
Pleomorphic adenoma	22	55
Warthin’s tumour	8	20
Mucoepidermoid carcinoma	1	2.5
Adenocarcinoma	2	5
Indifferentiated carcinoma	1	2
Lymphoma	1	2.5
Adenoid cystic carcinoma	1	2.5

Ductal adenoma	1	2.5
Oncocytoma	1	2.5
Monomorphic adenoma	1	2.5
Lipoma	1	2.5
Total	40	100

In the present study, pleomorphic adenoma was in 22 patients (55%) and Warthin's tumour in 20 (20%). Adenocarcinoma (5%) was the most common malignancy, followed by Mucoepidermoid carcinoma (2.50%).

Table 3: Contingency table between cytologic and histologic diagnosis

Parotid NAC	Benign Histology	Malignant histology	Total
Benign FNAC	33	2	35
Malignant FNAC	2	3	5
Total	35	5	80

The most common histopathological diagnosis was "benign lesion", that occurred in 35 patients.

Table 4: Evaluation of the usefulness of FNAC

	Value, %	95% Confidence Interval
Sensitivity	82	0.713 – 0.950
Specificity	98	
Positive Predictive Value (PPV)	92	
Negative Predictive Value (NPV)	97	
Likelihood Ratio for Positive test results	100.5	
Likelihood Ratio for Negative test results	0.17	
Kappa 0.85	0.84	
Prevalence of malignancies	0.1120	
Prevalence of benign findings	0.8743	
Accuracy for malignancy	96	
Accuracy for benign findings	82	

FNAC has 82% sensitivity and 98% specificity. Overall diagnosis accuracy was 97%, with 96% accuracy for malignancy and 82% for benign lesions. FNAC malignancies PPV and NPV were 92% and 97%, respectively. The probability ratio of positive test findings was 100.3 and negative test results was 0.17, where "positive" indicated "malignant". 0.112 percent had cancer.

Discussion

The presence of a lump in the salivary gland area might be difficult to diagnose due to uncertainty about its location and whether it is benign or cancerous. The majority of these instances arise in the parotid glands, whereas smaller proportions are seen in the submandibular, sublingual, and minor salivary glands. Parotid gland lesions include a wide range of histopathological variations. Tumors located in this specific location account for 3% of all head and neck tumors and 0.6% of all cancers in the human body.8 The origins of fine needle aspiration cytology (FNAC) may be traced back to the 1920s when it was introduced in both Europe and the United States. [9,10] FNAC, or fine-needle aspiration cytology, is a diagnostic technique that examines the physical characteristics of individual cells, groups of cells, and small tissue particles obtained by a needle. The diagnostic use of FNAC in identifying salivary gland masses is well demonstrated. Due to the potential for tumor spilling and facial nerve injury, the conventional open biopsy is no longer considered appropriate. [11] The approach exhibits a significant level of sensitivity in differentiating between cancers and non-neoplastic lesions of the salivary gland. [12,13]

Salivary gland tumors are an uncommon occurrence, representing between 3 to 10% of head and neck cancers and up to 0.6% of all malignancies in the human body. [14,15] Out of all salivary gland tumors, 80% specifically affect the parotid gland, and within this group, 80% of the tumors are non-cancerous. [16] The World Health Organization (WHO) has categorized parotid cancers into two types: epithelial and nonepithelial tumors. Despite its complexity, this categorization has gained global acceptance due to its benefits in predicting outcomes and guiding treatment decisions. This is because each tumor acts uniquely from others on a molecular level. [17] FNAC samples were collected from 50 patients. The FNAC findings were inconclusive in 12 instances (24%), indicating that a definitive diagnosis could not be made. In 33 cases (66%), the results suggested the presence of an inflammatory or benign lesion. In 5 cases (10%), the results indicated the presence of a malignant tumor. The current investigation found that pleomorphic adenoma was present in 22 patients, accounting for 55% of the cases, whereas Warthin's tumor was

found in 20 patients, representing 20% of the cases. Adenocarcinoma accounted for 5% of the cases, making it the most prevalent kind of malignancy. Mucoepidermoid carcinoma, on the other hand, constituted 2.50% of the cases. Out of the patients, 35 had a histological diagnostic of a "benign lesion", which was the most frequently seen diagnosis. Perisalivary or intrasalivary lymphoid tissue or lymph nodes are found in the parotid region. The submandibular group of lymph nodes are located on the side of the submandibular salivary gland. Ectopic salivary gland tissue can also be found in unusual locations, such as the upper cervical and submandibular lymph nodes. FNAC (Fine Needle Aspiration Cytology) is routinely conducted in all cases with parotid lesions, regardless of whether they are benign or malignant, palpable or not. The purpose of this procedure is to accurately determine the appropriate surgical approach. The primary objective of this examination is to differentiate between a benign and a malignant tumor. 20.6% of FNAC samples provide non-diagnostic results, perhaps attributed to the intricate nature of tissue structure. Many articles analyze cytological and histological data acquired from both the parotid and submandibular glands together. In addition, sensitivity, specificity, and accuracy are sometimes computed for certain histological subtypes, such as pleomorphic adenoma or mucoepidermoid carcinoma. Some studies only performed FNAC on individuals when cancer was suspected, which significantly impacts the sensitivity, specificity, and accuracy of the results. In contrast, FNAC is regularly conducted in other research, and the incidence of cancers is very low. [18]

In the retrospective investigation conducted by Atula et al. [19], the diagnosis of mucoepidermoid carcinoma, adenoid cystic carcinoma, lymphoma, and squamous cell carcinoma was often not accurately identified via fine-needle aspiration cytology (FNAC) alone. Within our series, we observed FNAC false-negative results in three cases: one involving acinic cell carcinoma, one involving mucoepidermoid carcinoma, and one involving lymphoma. Warthin's tumor was the cytological diagnosis in all of these instances. Que Hee et al. [20] found that FNAC had a poor accuracy rate of 56%. However, it is important to note that the specimens were collected by many physicians with diverse levels of skill, rather than by pathologists. The FNAC outcome is contingent upon both the operator's expertise and the diagnostic proficiency of the cytopathologist. Effective communication between the doctor and the pathologist ensures optimal outcomes.

The FNAC test demonstrated a sensitivity rate of 82% and a specificity rate of 98%. The cancer detection rate was 96%, the benign lesion detection rate was 82%, and the total diagnostic accuracy was 97%. The FNAC Positive Predictive Value (PPV) for malignancy was 92% and the Negative Predictive Value (NPV) was 97%. The Positive Likelihood Ratio (LR+) was 100.3 and the Negative Likelihood Ratio (LR-) was 0.17, with "positive" indicating "malignant". The incidence of cancer was 0.112. Several studies have estimated the positive predictive value (PPV) and negative predictive value (NPV) of fine-needle aspiration cytology (FNAC) in relation to the parotid gland. However, these results showed significant variation across the various investigations. The NPV reported by Cohen et al. [18] indicates that over 50% of the FNAC specimens, which lacked neoplastic cells, were really acquired from malignant lesions, as confirmed by histology. Consistent with our findings, Zurrida et al. documented a notable positive predictive value (PPV) of 100% and a substantial negative predictive value (NPV) of 90%. [21] The primary objective of this research is to determine if the data acquired from FNAC (Fine Needle Aspiration Cytology) can be effectively used in the clinical treatment of patients with parotid lesions. The current research has shown several situations in which such data might be beneficial and important. Regardless of the results of preoperative FNAC, it is advisable to surgically remove neoplastic lesions. However, it would be very advantageous to identify benign lesions beforehand in order to prevent unnecessary surgery and provide more accurate prognostic counseling to the patient.

Conclusion

Our research indicates that preoperative fine-needle aspiration cytology (FNAC) is helpful in accurately diagnosing parotid cancers. Parotid cancers may be effectively diagnosed and treated using this safe and reliable diagnostic method. Fine needle aspiration cytology is a dependable, economical, well-tolerated, and straightforward treatment. Furthermore, it aids in distinguishing between tumors before surgery, which may be advantageous for both the physician and the patient in preparing for the most suitable surgical approach.

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