

Evaluation of Preoperative Fine Needle Aspiration Accuracy in Diagnosis of Malignant Parotid Tumors

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How to cite this paper: Mandeel, A.Q., Qadami, E.M., Abdeen, Z.A., Al Mahari, S.A.I. and Alawi, S.H.A. (2020) Evaluation of Preoperative Fine Needle Aspiration Accuracy in Diagnosis of Malignant Parotid Tumors. *International Journal of Otolaryngology and Head & Neck Surgery*, 9, 101-110.

<https://doi.org/10.4236/ijohns.2020.93014>

Received: April 28, 2020

Accepted: May 19, 2020

Published: May 22, 2020

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Abstract

Objective: To evaluate the diagnostic accuracy of fine needle aspiration (FNA) in detecting malignant parotid tumors. **Design:** A retrospective study of cases series. **Setting:** Salmaniya Medical Complex, Otorhinolaryngology Department, Kingdom of Bahrain. **Methods:** A retrospective study was carried out, between January 2009 and December 2018, for all patients diagnosed with parotid tumors at the Department of Otorhinolaryngology, Head and Neck Surgery at Salmaniya Medical Complex, Manama, Kingdom of Bahrain. Data collection was made from medical records, I-seha and laboratory information system (LIS). 87 patients underwent parotidectomy, of which 30 were excluded due to unsatisfactory diagnoses or missing data. The results of fine needle aspirations were analyzed and compared with the corresponding histopathologic diagnosis. Estimation of sensitivity, specificity, negative predictive value, positive predictive value and accuracy of FNA were calculated. **Results:** Among the 57 evaluated cases, four cases were further excluded from the final analysis due to unsatisfactory FNA results, therefore only 53 cases remained. The mean age of patients was 48.6 ± 17.2 years. A concordance with histopathology results was observed. 47 cases were diagnosed as benign and five cases were malignant, however, 1 case was diagnosed as malignant by FNA, but not in histopathology. The overall diagnostic accuracy was 98.1% and the prevalence of parotid malignancy was 9.4%. Sensitivity and specificity were 100% and 97.9%, respectively. Positive predictive value was 83.3% while negative predictive value was 100%. **Conclusion:** Fine needle aspiration is a highly sensitive and specific test in evaluating malignant parotid gland tumors. It is useful and accurate, especially when used hand by hand with the

clinical assessment and radiological findings.

Keywords

Fine Needle Aspiration, Histopathology, Malignant, Parotid, Salmaniya Medical Complex, Tumors

1. Introduction

The parotid glands are the largest of the three main salivary glands [1]. Their function is the secretion of saliva. Saliva is important for lubrication, swallowing, teeth protection and digestion. Salivary gland masses comprising a wide range of non-neoplastic lesions along with variety of benign and malignant neoplasms [1] [2]. Different types of tumors can arise from the parotid glands due to their histological diversity [3] [4]. Benign tumors are more common than malignant tumors [5] [6]. The two most common benign tumors are pleomorphic adenoma and Warthin's tumor [5]. Salivary gland tumors constitute 2% - 6.5% of head and neck tumors [6] [7]. Of these 80% - 85% are located in the parotid glands [1] [6]. The malignancy rate for parotid tumors has been reported to be usually between 14% - 27% [2]. Mucoepidermoid carcinomas are the most common malignant lesions of the parotid glands [5].

The prevalence of these tumors is inconstant among different ethnicities and populations in different geographical locations [6]. Differentiation between benign and malignant tumors is difficult and cannot be carried out by physical examination and radiological studies alone [3] [4].

FNA cytology plays an important role in the initial evaluation of salivary gland lesions. FNA was first familiarized in 1920 for the assessment of parotid lesions and gained popularity 50 years later [6]. It is safe, simple, cost-effective and minimally invasive but its accuracy is doubtful, when compared to the gold standard histopathology [7]. FNA can provide helpful information for surgery planning and counselling patients regarding expectations from the surgery and after care prospects [8]. However, others emphasize that the management does not change regardless of the FNA result [9] [10].

Open biopsies are contraindicated as they can result in a potential risk for recurrence, secondary to tumor cell seeding [5]. Furthermore, a subsequent curative parotid surgery can be complicated by a previous open biopsy.

Variability in the diagnostic accuracy varies with clinical experience and geographical location owing to differences in referral patterns as well as in the prevalence of benign or malignant disease [10]. In our center, the standard methods for pre-operative assessment include radiological imaging (CT-SCAN) and FNA.

The aim of this study is to determine the diagnostic accuracy of FNA for detecting malignant parotid tumors preoperatively in Salmaniya Medical Complex (SMC), Manama, Kingdom of Bahrain, in which FNA accuracy had not been assessed previously.

2. Methods

A retrospective study was conducted for all patients diagnosed with benign or malignant parotid tumors who underwent parotidectomy in the Department of Otolaryngology-Head and Neck Surgery at SMC in Manama, between January 2009 and December 2018. It included all patients diagnosed with parotid tumors who underwent parotidectomy with adequate medical record and we excluded all patients with missing FNA cytology results or histopathology results or both. The patients with missing data or undetermined results were eliminated and were not involved in analysis.

In our institution, the standard procedure for FNA is performed in the outpatient setting, either the Swedish technique using a needle and needle holder in order to use suction to obtain the specimen, or the French technique (capillary method), by using only a needle [11].

The aspiration is done either by an experienced pathologist in the FNAC clinic using 23 - 25 G needles or under ultrasound guidance in the radiology department by an interventional radiologist. The aspirated material is expelled on the slides and is smeared. Half of the slides are kept for air drying; which are stained by DiffQuik stain and the other half is fixed in 95% alcohol and is stained by Papanicolaou stain. Bedside adequacy is checked by the pathologists.

The remaining material usually kept for a cell block, in which some ancillary testing is done later in order to reach to a final diagnosis in controversy cases.

If a lymphoma is suspected at the time of checking the adequacy, a sample is sent for flowcytometry.

The slides are then studied carefully by the cytopathologists to reach to a final interpretation.

Patients data were obtained from medical records, I-seha and laboratory information system (LIS). The collected data were: patients demographics including age and gender; lesion characteristics including extension and location of the tumor (superficial or deep lobe or both), lesion size, patient's previous cancer history and the FNA method used (blind or ultrasound guided).

Patients data and lesions characteristics were compared and analyzed using SPSS version 23. Tumor size was categorized into 2 groups using 50th percentile (4 cm) as cut-off point.

The cases were categorized into 3 groups: benign, malignant, or insufficient for diagnosis. Cases which were reported to have unsatisfactory FNA, were not included in the analysis and results. The proportion of each disease was calculated. After-that, the results of FNA were then compared with the histology results. The cases were classified as true positive (TP) when patients were diagnosed with malignancy by both FNA and histopathology, as true negative (TN) when patients did not have malignancy on both FNA and histopathology, as false positive (FP) when malignancy were diagnosed by FNA but not with histopathology and as false negative (FN) when malignancy was diagnosed by histopathology but not FNA.

The non-parametric statistical analysis was used to determine the sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV) and the overall accuracy with their 95% confidence interval (CI) was estimated for FNA based on histopathology results using MEDCALC.org and the following below formulas [12]:

$$\text{Sensitivity} = \text{TP}/(\text{TP} + \text{FN});$$

$$\text{Specificity} = \text{TN}/(\text{TN} + \text{FP});$$

$$\text{PPV} = \text{TP}/(\text{TP} + \text{FP});$$

$$\text{NPV} = \text{TN}/(\text{TN} + \text{FN});$$

$$\text{Total accuracy} = \text{TP} + \text{TN}/\text{total number of cases}$$

Our study was ethically approved by Salmaniya Medical Complex research's committee and verbal consent was obtained from patients.

3. Results

Of the 87 parotidectomy investigated cases, 30 of them were excluded due to missing FNA findings or for whom FNA was not performed, thus a total of 57 cases left to be examined. Results of demographic data and lesions characteristics are illustrated in **Table 1**. The mean age of patients was 48.61 ± 17.2 years. 22 patients (38.6%) were females and 35 (61.4%) were males. 91.2% of examined patients did not have a previous cancer history. The size of the tumor was less than or equal 4 cm in 47 cases (82.5%) and more than 4 cm in ten patients (17.5%). In 43.9% of cases, the superficial lobe was affected, followed by 3.5% in deep lobe and 52.6% for both lobes. Fine needle aspiration diagnoses were obtained using the direct FNA blind method in 75.4% of the cases, where as 17.5% were by using ultrasound guidance. The FNA method used for the remaining cases (7%) was unknown (**Table 1**).

Of the 57 cases, four cases were excluded due to insufficient or inconclusive specimens. Of the satisfactory sample (N = 53), 47 cases were benign and six cases were malignant based of FNA results (**Table 2**). Pleomorphic adenoma was the most common tumor (N = 27; 56.2%) and the remainder were Warthin's tumor, chronic sialadenitis and myoepithelioma. The six malignant lesions were mucoepidermoid carcinoma, basal cell adenocarcinoma, undifferentiated carcinoma Acinic cell carcinoma and (DLBCL, NOS) diffuse large B-cell lymphoma (**Table 2**).

Histopathology results revealed that 52 cases were benign and five cases were malignant. Of the benign lesions again, pleomorphic adenoma was the most common benign tumor (67.3%) followed by Warthin's tumor (26.9%), cavernous hemangioma (3.9%) and basal cell adenoma (1.9%). Mucoepidermoid carcinoma was the most common malignant lesion (40% of cases) as shown in **Table 2**.

A comparison was made between FNA and histopathology diagnoses. A concordance was established in 100% of malignant cases and 87.5% of benign cases

Table 1. Demographics and lesion characteristics (N = 57).

Variable	N (%)
Age , mean (SD)	48.6 (17.2)
Gender	
Female	22 (38.6)
Male	35 (61.4)
Cancer history	
No	52 (91.2)
Yes	5 (8.8)
Size of lesion	
≤4 cm	47 (82.5)
>4 cm	10 (17.5)
Depth of lesion	
Superficial lobe	25 (43.9)
Deep lobe	2 (3.5)
Both	30 (52.6)
Fine needle aspiration method	
Blind	43 (75.4)
Ultrasound guided	10 (17.5)
Unknown	4 (7.0)

Table 2. Diagnosis of parotid lesions using fine needle aspiration and histopathological analysis.

Diagnosis of parotid lesions	(N) %
FNA diagnoses	
Malignant lesions	6
Mucoepidermoid carcinoma low grade	2 (33.3)
Basal cell adenocarcinoma	1 (16.7)
Undifferentiated carcinoma	1 (16.7)
Acinic cell carcinoma	1 (16.7)
B-cell lymphoma	1 (16.7)
Benign lesions	47
Pleomorphic adenoma	27 (56.2)
Warthin's tumor	18 (37.5)
Chronic sialadenitis	1 (2.1)
Myoepithelioma	1 (2.1)
Histopathology diagnoses	N %
Malignant lesions	5
Mucoepidermoid carcinoma low grade	2 (40.0)
Diffuse B-cell lymphoma	1 (20.0)
Undifferentiated carcinoma	1 (20.0)
Basal cell adenocarcinoma	1 (20.0)
Benign lesions	52
Pleomorphic adenoma	35 (67.3)
Warthin's tumor	14 (26.9)
Cavernous hemangioma	2 (3.9)
Basal cell adenoma	1 (1.9)

(Table 3). The true positive (TP) cases for malignancy were 5, while the true negative cases for malignancy were 48. There were no false negative cases for

Table 3. Comparison of fine needle aspiration (FNA) and histopathology diagnoses of parotid lesions.

Diagnosis	N	Status
Fine needle aspiration		
Malignant lesions		
Mucoepidermoid low grade carcinoma	2	
Basal cell adenocarcinoma	1	
Undifferentiated carcinoma	1	
Acinic cell carcinoma	1	
B-cell lymphoma	1	
Benign lesions		
Pleomorphic adenoma	27	
Warthin's tumor	18	
Chronic sialadenitis	1	
Myoepithelioma	1	
Insufficient for diagnosis	4	
Histopathology diagnosis		
Malignant lesions		
Mucoepidermoid carcinoma low grade	2	TP
Basal cell adenocarcinoma	1	TP
Undifferentiated carcinoma	1	TP
Diffuse B-cell lymphoma	1	TP
Benign lesions		
Pleomorphic adenoma	27	TN
Pleomorphic adenoma	4	TN (Warthin's tumor)
Pleomorphic adenoma	1	TN (Myoepithelioma)
Pleomorphic adenoma	1	FP (Acinic cell carcinoma)
Warthin's tumor	14	TN
Cavernous hemangioma	1	TN
Basal cell adenoma	1	Insufficient
Cavernous hemangioma	1	Insufficient
Pleomorphic adenoma	2	Insufficient

TN—true negative, TP—true positive, FP—false positive, FN—false negative.

malignancy, but there was one false positive case which was diagnosed as Acinic cell carcinoma in FNA cytology; however, it was diagnosed as pleomorphic adenoma in histopathology (**Table 3**).

A statistical analysis of the 53 cases was carried out to assess the diagnostic accuracy to detect malignant lesions, specificity, sensitivity, PPV, NPV, and the prevalence of parotid malignant tumors (**Table 4**). A sensitivity of 100% was recorded. The specificity was 97.9%, and the diagnostic accuracy was 98.1%. The positive and negative predictive values were 83.7 and 100%, respectively. The prevalence of malignancy in our study was 9.4%.

4. Discussion

Our experience with FNA procedure for detecting malignant parotid tumors revealed that FNA cytology is safe, simple and efficient in the diagnosis of patients

Table 4. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of fine needle aspiration (FNA).

Values	Histopathology		Total	Percentage	95% Confidence Interval
	Cancer	Non-Cancer			
Fine needle aspiration					
Positive	5 (TP)	1 (FP)	6		
Negative	0 (FN)	47 (TN)	47		
Total	5	48	53		
Disease prevalence				9.4	(3.1 - 20.7)
Sensitivity				100	(47.8 - 100)
Specificity				97.9	(88.9 - 100)
PPV				83.7	(42.6 - 97.3)
NPV				100	(100)
Accuracy				98.1	(89.9 - 100)

TN—true negative, TP—true positive, FP—false positive, FN—false negative, PPV—positive predictive value, NPV—negative predictive value.

with parotid gland malignancy [6]. When used preoperatively, FNA offers the clinicians with valuable information and helps making a decision regarding patient management and surgical intervention [6] [9]. The primary treatment of malignant parotid gland tumors is mostly surgery, but the extent of surgery depends on the histopathologic type [5]. However, Zbären *et al.* (2018), believes that for distinguishing malignant versus benign neoplasms, the sensitivity is satisfactory and the accuracy of tumor typing and grading is low [2]. Possibly, histologic type, frequency of uncommon lesions and experience of the cytologist influence these results. He also stated that FNA can be inappropriate to guide the extent of surgery for malignant neoplasms of the parotid gland [2].

In our study, in most of cases, an agreement was seen between FNA and histopathology results with 100% and 87.5% for malignant and benign cases, respectively. However, the analysis of histopathological biopsy is still considered the gold standard for assessing tumors for malignancy [13]. Alternatively, surgical biopsies can lead to significant complications such as fistula formation, facial nerve injury or tumor seeding [1]. They are also prone to sampling errors [5].

This study reports the results of FNAs of parotid masses over a 10-year period at a tertiary care center in SMC. The diagnostic accuracy, sensitivity, specificity, PPV and NPV of preoperative FNA specimens of parotid gland malignant tumors were found to be 98.1%, 100%, 97.9%, 83.7% and 100%, respectively (Table 4), indicating satisfactory results as compared with those previously reported from other institutions (Table 5). In addition, 100% of the malignant tumors and 87.5% of the benign tumors were classified accurately with regard to tumor type on cytologic evaluation.

Similar studies reported the accuracy of FNA ranging from (80% to 92%), and a sensitivity ranging (46% - 92%) as shown in Table 5 [1]-[10] [13] [14] [15].

Table 5. Comparison of the diagnostic efficacy of FNA for assessment of parotid masses reported in the present study and in the previous studies.

Studies	Year	Total FNA	Sensitivity (%)	Specificity (%)	Accuracy (%)	PPV (%)	NPV (%)
Present study	2020	57	100	97.9	98.1	83.7	100
Ronchi <i>et al.</i> [8]	2019	34	92	86	-	-	-
Altin <i>et al.</i> [5]	2018	194	69	89.6	86.5	54.1	94.2
Marzouki <i>et al.</i> [1]	2017	42	50	100	92.1	100	91.4
Santigo <i>et al.</i> [9]	2016	88	46	100	91	100	90
Rezvani <i>et al.</i> [6]	2015	200	53	93	82	72	84
Mallon <i>et al.</i> [10]	2013	201	52	98	92	78	93
Nugansangiam <i>et al.</i> [13]	2012	290	81.3	99.1	97	92.9	97.5
Ali <i>et al.</i> [14]	2011	129	84	98	94	93	95
Stramandnoli <i>et al.</i> [3]	2009	106	68.2	87.7	82.3	68.2	87.7
Cohen <i>et al.</i> [15]	2004	169	73	87	80	84	77

The reason for this wide variability may be technical factors, such as experience of the cytopathologist/radiologist performing the FNA, and the availability of immediate and expert cytopathologic examination to assess adequacy of the specimen. However, our study showed a higher percentage of both, which could be attributed to our small sample size. But since the sensitivity in our center is 100%, we can use the FNA as a screening tool for detection of malignant parotid tumors. Furthermore, previous studies showed higher range of specificity ranging from (86% - 100%) [1]-[10] [13] [14] [15], which is similar to our study finding. The high rate of false negative and low sensitivity was the major limitation to FNA use in previous studies, but in our study, there were no false negative cases and the sensitivity was high. In our study, five cases were malignant as detected by both FNA and histopathology. This resulted in 100% sensitivity. One case revealed to be negative by histopathology, but positive by FNA, which could be attributed to sampling errors, and this resulted in a lower specificity (97.9%). Additionally, four FNA specimens were insufficient for diagnosis, probably due to scanty tissue sampling, which may be explained by the nature of the mass itself (solid vs. cystic). Other researchers reported PPVs for FNA of salivary gland tumors ranging from (54.1% - 100%) and NPVs ranged from (77% - 97.7%) [1]-[10] [13] [14] [15]. Our PPV was similar to other studies, which could be attributed to the small sample size and low prevalence of malignancy of parotid in our population but our NPV was 100% which is higher than other studies. The most common benign neoplasm was pleomorphic adenoma which accounted for 50.9% of all neoplasms and Warthin's tumor was the second most common (26.4%). The predominance of these two benign neoplasms was similar to those previously reported in a number of studies [1] [6] [13]. In this study, malignant neoplasms accounted for five cases (9.4%). The rate of malignant neoplasm was

lower than other reports which probably were due to our small sample size. Limited sample size and inadequate clinical data were reasons of limitations to this study. We therefore recommend further measures to be taken in SMC, to ensure sufficient and accurate data present in future for better patient management.

5. Conclusion

In conclusion, based on our study, FNA is a highly specific and sensitive tool in diagnosing malignant parotid tumors. Unsatisfactory specimen was the reason behind invalid interpretation. We support its use as an initial diagnostic tool because it's a safe, rapid and minimally invasive approach. However, future studies are required for comparison and to assess factors influencing accuracy of FNA.

Acknowledgements

The authors would like to thank Dr. Abdulkarim Alsaie for suggesting the research topic. We would like also to thank the training directorate for support and encouragement.

Ethical Consideration

Ethical approval submitted.

Funding

No funding agency available.

Author Contribution

All authors share equal effort contribution towards 1) substantial contributions to conception and design, acquisition, analysis and interpretation of data; 2) drafting the article and revising it critically for important intellectual content; and 3) final approval of the manuscript version to be published.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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