CLINICAL STUDY

THE ROLE OF FINE NEEDLE ASPIRATION CYTOLOGY AND MAGNETIC RESONANCE IMAGING IN THE MANAGEMENT OF PAROTID MASSES

Gamze ATAY[1], MD; Cavid CABBARZADE[1], MD; Bahar KAYAHAN[1], MD; Burçe ÖZGEN[2], MD; Ali Şefik HOŞAL[1], MD; Ahmet Bülent SÖZERİ[1], MD; Ergin TURAN[1], MD

[1]Department of Otolaryngology, Hacettepe University Medical School, Ankara, Turkey [2]Department of Radiology, Hacettepe University Medical School, Ankara, Turkey

SUMMARY

Objective: Evaluation of parotid gland masses requires differentiation of both neoplastic from non-neoplastic lesions and benign from malignant tumors in order to determine the most suitable management method. This retrospective study aimed to compare the diagnostic value of fine needle aspiration cytology (FNAC) and MRI in the management of parotid gland masses.

Materials and Methods: The study included 193 patients that underwent parotid gland surgery between 2004 and 2010. Preoperatively, 155 patients underwent FNAC and 73 underwent MRI. Among the patients that underwent MRI, diffusion-weighted imaging (DWI) was performed in 26. Partial parotidectomy was performed in 170 patients, and 16 had total and 4 patients had radical parotidectomy. Incisional biopsy was performed in 3 patients that were previously diagnosed with lymphoma. FNAC and MRI findings were compared with histopathological diagnoses.

Results: For the diagnosis of malignant pathologies, the sensitivity, specificity, and accuracy of FNAC was 80.7%, 96.2%, and 78.1%, respectively, versus 73.3%, 88.2%, and 85.7%, respectively, for MRI.

Conclusions: FNAC and MRI findings were equally effective for differentiating between benign and malignant parotid masses. MRI with DWI and FNAC had similar diagnostic value for determining definitive histopathological diagnoses; however, MRI aided surgical management via avoiding additional information when compared to FNAC. Retrospective evaluation of patients included in the study showed that FNAC findings did not result in a change to the predetermined method of management of the parotid masses.

Keywords: Fine needle aspiration cytology (FNAC), parotid gland masses, magnetic resonance imaging (MRI)

PAROTİS KİTLELERİNE YAKLAŞIMDA İNCE İĞNE ASPİRASYON BİYOPSİSİ VE MANYETİK REZONANS GÖRÜNTÜLEMENİN ROLÜ

ÖZET

Amaç: Parotis bezi kitlelerine yaklaşımda neoplastik-nonneoplastik, benign-malign ayırımının yapılması tedavi şeklinin planlanmasında önemlidir. Bu retrospektif çalışmada parotis bezi kitlelerine yaklaşımda ince iğne aspirasyon biyopsisi (İİAB) ve manyetik rezonans görüntülemenin (MRG) tanısal değerini karşılaştırmak amaçlandı.

Gereç ve Yöntemler: Çalışmaya 2004-2010 yılları arasında kliniğimizde parotis cerrahisi geçirmiş olan 193 hasta dahil edildi. Preoperatif olarak 155 hastaya İİAB yapıldı, 73hastaya MRG çekildi. MRG çekilen hastaların 26'sında difüzyon ağırlıklı görüntüleme (DWI) mevcuttu. Hastalardan 170'ine parsiyel, 16'sına total ve 4'üne radikal parotidektomi yapıldı. Daha önceden lenfoma tanısı olan 3 hastaya insizyonel biopsi yapıldı. İİAB ve MRG sonuçları histopatoloji sonuçları ile karşılaştırıldı.

Sonuçlar: Malign patolojileri saptamada sensitivite, spesifisite ve yararlılık oranı İİAB'inde sırasıyla %80.7, %96.2 ve % 78.1, MRG'de sırasıyla 73.3%, 88.2% ve 85.7% olarak bulundu.

Sonuç: Parotis kitlelerinin malign benign ayırımında İİAB ve MRG sonuçlarının birbirine yakın olduğu, DWI yapılmış MRG ile İİAB'nin kesin histopatolojik tanı koymada tanısal potansiyellerinin benzer olduğu görüldü. Ancak MRG´nin İİAB´ye kıyasla sağladığı ek bilgiler nedeniyle cerrahi plan oluşturmada katkısı olduğu saptandı. Çalışmaya katılan hastalar retrospektif olarak değerlendirildiğinde, İİAB'nin parotis kitlelerine yaklaşımı değiştirmediği tespit edildi.

Anahtar Sözcükler: İnce iğne aspirasyon biyopsisi, parotis kitleleri, manyetik rezonans görüntüleme

INTRODUCTION

Salivary gland tumours constitute approximately 3%-5% of all head and neck neoplasms. In all, 80% involve the parotid gland, of which 75%-80% are benign tumors[1]. Differentiation of neoplastic from non-neoplastic lesions, and benign from malignant tumors is critically important in the management of parotid gland masses, as it facilitates determination of the necessity and extent of surgery.

Corresponding Author: Gamze Atay MD Hacettepe Üniversitesi, Kulak Burun Boğaz, Ankara, Türkiye, E-mail: drgamzeatay@gmail.com

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As physical examination is not always sufficient for a differential diagnosis of parotid gland masses, additional diagnostic tools, such as fine needle aspiration cytology (FNAC) and MRI, may play a role in the work-up of such patients.

FNAC is an easy, safe, and well-tolerated procedure associated with relatively low cost and low morbidity; therefore, it is widely accepted by most surgeons[2,3]. In addition, it prevents unnecessary surgical intervention in cases of infectious processes, lymphomas, or metastatic lesions[4]; however, its usefulness in parotid masses remains controversial. Opponents of FNAC claim that its accuracy is

inconsistent; in particular, it has a high false negative rate for identification of malignancy, and it may be misleading in cases of masses composed of both benign and malignant counterparts. Moreover, the sample collection technique itself and the level of experience of the cytopathologist may limit the reliability of FNAC[5,6].

Another commonly used method for preoperative evaluation of parotid masses is MRI, which can be used to determine the exact localization of such masses in the superficial or deep lobe of the gland. It provides information about the proximity of lesions to the facial nerve and certain anatomical structures in the head and neck region. MRI can also detect additional masses and pathological lymph nodes that are not noted in physical examination, so that the surgical plan can be modified accordingly. Furthermore, benign and malignant tumors can be differentiated using MRI[6-8]. Diffusion-weighted imaging (DWI) provides additional functional information that can aid in specific histopathological diagnosis[8].

The present study aimed to determine the following: 1. The value of FNAC and MRI in the preoperative assessment of parotid gland masses; 2. If either method was superior to the other; 3. The additional benefit of DWI.

MATERIAL and METHODS

This retrospective study consisted of 193 patients that underwent parotid gland surgery between June 2004 and December 2010. The study group included 103 females and 90 males with a mean age of 48.5 years (range: 10-83 years). Among the patients, 155 underwent FNAC and 73 underwent MRI preoperatively (50 underwent both FNAC and MRI). DWI was used in 26 of the patients that underwent MRI.

Of the 193 patients with parotid gland masses, 170 underwent partial, 16 underwent total, and 4 underwent radical parotidectomy. In total, 11 of the patients required neck dissection during primary surgery. In 3 patients incisional biopsy was obtained from the lesion because they were previously diagnosed with lymphoma.

A 22-gauge needle and a 10-mL syringe were used to obtain samples for FNAC. The aspirate was expelled onto glass slides and spread uniformly as a fine layer using another thinner slide. The smears were air-dried, fixed in alcohol, and then stained with Papanicolaou stain.

MRI was performed using a 1.5T system (Magnetom, Symphony, Siemens Medical Systems, Erlangen, Germany or Intera, Achieva, Philips, Netherlands). The imaging protocol included axial and sagittal T1-weighted (T1W) spin-echo (SE), axial and coronal T2-weighted (T2W) turbo SE, and axial and coronal post-contrast T1W SE imaging. All studies were performed as nasopharynx MRI with 3-mm slice thickness, fat suppression on T2W, and post gadolinium images. Additionally, 26 studies also included single shot echo planar DWI (3 b values with a maximum of 1000 s mm–2 and a TR/TE of 5100/137 ms, matrix of 96-128, and 3-mm slice thickness). MRI was evaluated by a radiologist with extensive experience in head and neck radiology.

The findings were statistically analyzed in order to determine the sensitivity, specificity, negative and positive predictive values and accuracy of FNAC and MRI. SPSS v.18.0 for Windows software (SPSS, Inc., Chicago, Illinois, USA) was used for statistical analysis.

RESULTS

Among the 193 patients with parotid masses, the histopathological diagnosis was malignant in 33 (18.1%) and benign in 160 (81.9%), of which 143 (89.5%) were neoplastic and 17 (10.4%) were non-neoplastic. Among the benign lesions, pleomorphic adenoma was the most frequent (n = 76 [46.9%]), followed by Warthin's tumor (n = 45 [27.7%]). Mucoepidermoid carcinoma (n = 6 [19.3%]) was the most common malignant pathology (Table 1).

FNAC was used in 155 patients (80.5%). FNAC findings were defined as benign, malignant, and non-diagnostic. Insufficient material and cytology that could not be characterized were considered non-diagnostic. The sensitivity, specificity, and accuracy of FNAC for malignant lesions were 80.7%, 96.2%, and 78.1%, respectively (Table 2). For the most common pathologies-pleomorphic adenoma and mucoepidermoid carcinoma-the positive predictive value (PPV) of FNAC was 78.5% and 95.3%, respectively.

MRI was performed in 73 (37.8%) patients, of which 26 (13.4%) had DWI. MRI findings were also defined as benign, malignant, and non-diagnostic.

Masses with irregular borders, infiltration of surrounding structures, contrast material enhancement, heterogeneity, and facial nerve invasion were considered signs of malignancy. The sensitivity, specificity, and accuracy of MRI for malignant tumors were 73.3%, 88.8%, and 85.7%, respectively (Table 2).

Table 1. Histopathological diagnoses following parotid surgery.

Benign	n = 160	Malignant	n = 33
Neoplastic	143	Malignant tumor	33
Pleomorphic adenoma	76	Mucoepidermoid carcinoma	6
Warthin's tumor	45	Adenocystic carcinoma	4
Adenoma	6	Acinic cell carcinoma	4
Myoepithelioma	7	Malignant melanoma	4
Cystadenoma	3	Lymphoma	4
Miscellaneous*	6	Miscellaneous***	11
Non-neoplastic	17		
Cyst	8		
Sialoadenitis	3		
Miscellaneous**	6		

*Cystadenoma, oncocytoma, lipoma, schwannoma, inflammatory myofibroblastic tumor, and synchronous tumor (pleomorphic adenoma + Warthin's tumor) (n = 1 for each).

**Lymphoid cells in 3 patients, active chronic inflammation in 1 patient, and granulomatous reaction in 2 patients.

***Adenocarcinoma, squamous cell carcinoma, epithelial myoepithelial carcinoma, sebaceous carcinoma, carcinoma ex pleomorphic adenoma, hybrid carcinoma (salivary duct carcinoma + myoepithelial carcinoma) (n = 1 for each). Adenocarcinoma metastasis in 2 patients and ductal carcinoma in 3 patients.

Table 2. The diagnostic value of FNAC and MRI for parotid masses.

	FNAC (n = 155)	MRI (n = 73)
Sensitivity (%)	80.7	73.3
Specificity (%)	96.2	88.8
Accuracy (%)	78.1	85.7
Positive predictive value (%)	78.5	68.7
Negative predictive value (%)	95.3	90.9

DISCUSSION

Differentiation of neoplastic and non-neoplastic parotid gland masses is important because it helps determine whether or not surgery is required. If a surgical plan is to be made, benign and malignant masses should also be differentiated in order to determine the most suitable approach. Both differentiations may be achieved using FNAC, which is among the most commonly used methodseven though its benefit remains controversial[2,9-11].

FNAC is a well-tolerated and easy technique that does not require general anesthesia; it is almost totally painless. Nonetheless, in rare cases complications, such as infection, hemorrhage, facial nerve damage, and tumor seeding, can occur[3,5-7,12-14]. In the present study precautions, including avoidance of repetitive aspiration, a strict anti-sepsis protocol, and use of relatively thin needles (22 gauge), were used and therefore none of the patients had complications.

The sensitivity, specificity, and accuracy of FNAC was reported to be 57%-96%, 86%-100%, and 92%-94%, respectively[5-7,10,15,16], which is similar to the present study's findings (Table 2). The sensitivity of FNAC in diagnosing the 3 most common malignancies of the parotid gland (mucoepidermoid carcinoma, squamous cell carcinoma, and adenocarcinoma) is relatively low[4], which might explain the relatively low sensitivity rate observed in

the present study and others. Moreover, the relatively high rate of non-diagnostic findings and false negativity limits the more widespread use of FNAC. The rate of non-diagnostic FNAC findings was reported to be 3%-34%[9]. The accuracy of FNAC is closely related to the subjective skills and experience of those obtaining the aspirate and evaluating the specimen[4,5,16]. In the present study, 17.6% of FNAC findings were non-diagnostic, which may have been due to the lack of repetitive aspirations[5]. Another reason is the union of insufficient materials and uncharacterized results under the headline of "non-diagnostic".

The parotid gland can harbor multiple tumors of distinct histological types, which may also limit the benefit of FNAC. Multiple tumors, including biphasically differentiated, synchronous, hybrid, or malignant mixed tumors, require identification of the all components for optimal management[17,18]. FNAC of such tumors may cause clinicians to overlook ≥1 components, resulting in inappropriate treatment. In the present study 1 patient was diagnosed with a hybrid tumor of salivary ductal carcinoma with myoepithelial carcinoma components. FNAC findings indicated that this tumor was high-grade carcinoma". Another tumor that was composed of pleomorphic adenoma and Warthin's tumor was acrossed and FNAC findings in that case were "non-diagnostic". Although FNAC was not misleading in these 2cases, it did not contribute to the treatment process. As such, we think use of FNAC alone might be insufficient for the diagnosis of multiple tumors.

Aspirate obtained via FNAC may inaccurately indicate the structural properties of a mass. For example, adenoid cystic carcinoma has similar cellular and extracellular structures as the most common benign tumor of the parotid gland-pleomorphic adenoma-, and may be confused with the other cytological appereances. Similarly, as melanoma cells lack specific cytological properties they might resemble epithelial cells[10]. Additionally, masses with cystic components, such as cystic mucoepidermoid carcinoma, Warthin's tumor, and benign cystic lesions, may be challenging for FNAC, which may not always be capable of differentiating them[9,10].

Use of FNAC is relatively more suitable in the pediatric population, in which the incidence of neoplasia of the parotid gland is lower, inflammatory or immune sialadenitis is more likely, and parotid gland swelling is considered to be associated with systemic disease, and in cases in which surgical exploration is considered high risk[19]. In addition, FNAC is more useful for pathologies that primarily require non-surgical management, such as inflammatory processes, metastatic tumors, and lymphoma[3,4]; however, the diagnosis of lymphoma is based on immunohistochemical findings and tumor markers, which necessitates a larger sample size than FNAC aspirate, so that surgical biopsy may not be avoidable[4,20].

Despite the contribution of diagnostic tools, the definitive diagnosis of parotid gland masses depends on partial parotidectomy, which is also the method of choice for treating most benign and malignant parotid tumors[4,21,22]. In the present study 170 of the 192 patients (88.5%) underwent partial parotidectomy. Histopathological diagnosis of these patients yielded 12 malignancies; partial parotidectomy was considered to be sufficient treatment in 5 of these patients (Table 3). As such, FNAC findings did not result in a change in treatment approach.

Imaging modalities are essential during the preoperative evaluation of parotid masses. They provide valuable information about the localization of masses and their relationship with surrounding structures, and can identify intraparotid and extraparotid lymph nodes, and cystic and solid components of a lesion. Moreover, MRI can detect multicentric tumors, and can be used to determine the morphological properties of a mass and its relationship with the facial nerve[6-8,10,21]. Data of higher quality can be obtained using MRI than by using computed tomography (CT). Based on the patient data presented herein, especially data obtained via MRI, we think that MRI is more useful than FNAC for choosing the optimal surgical plan.

The sensitivity, specificity, and accuracy of MRI for parotid gland malignancies is reported to be 81%-88%, 77%-100%, and 83%-96%, respectively[6-8]. In the present study the diagnostic value of MRI was consistent with that previously reported (Table 2).

Conventional MRI shows the morphological structure of a mass. Invasion of the surrounding structures, border irregularity, and hypointensity on T2W sequences are findings that are indicative of malignancy[6-8]. DWI provides additional tissue-specific information; therefore, the use of DWI is becoming more common, including for imaging of head and neck neoplasms. For parotid gland lesions DWI does not increase the accuracy of conventional MRI, but it does aid in specific histopathological diagnosis. A rare study by Yerli et al. (2010) on this subject reported that MRI with DWI was of similar value for the diagnosis of the specific

histopathological type of parotid gland masses as was FNAC. It was also reported that due to the proximity of the apparent diffusion coefficient (ADC) values, Warthin's tumors and carcinomas might be difficult to differentiate using DWI[8].

In the present study FNAC was used in 132 patients, whereas DWI was used in only 26, a difference in number that results in statistical analysis of low reliability; therefore, calculations were not performed. Nonetheless, the diagnostic power of FNAC and DWI for determining specific histopathological type was similar (Table 4).

As in the previously mentioned Yerli et al. study, the differential diagnosis of Warthin's tumor and carcinoma was also challenging in the present study; based on DWI, 1 patient with a Warthin's tumor was diagnosed as malignant and another patient with an adenoid cystic carcinoma was misdiagnosed as Warthin's tumor.

MRI used in conjunction with FNAC increases the sensitivity of malignant diagnoses of the parotid gland, but not significantly[6]. If application of both diagnostic methods is planned, it would be appropriate to perform FNAC after MRI, as complications, such as hemorrhage and necrosis, could occur during or after FNAC and may negatively affect MRI findings[6,23].

The present study is a rare comparison of FNAC and DWI in the work-up of parotid gland masses. Unfortunately, the number of patients that underwent MRI and DWI was small as to be considered a limitation of the study. We think larger patient series might clarify the value of DWI in diagnosing parotid gland masses.

Table 3. Adjuvant therapy requirement required in patients with malignant pathology following partial parotidectomy.

Histopathology	Surgical Margin	Adjuvant Therapy
Malignant melanoma	Intact	RT
Malignant melanoma	Positive	ChT + RT
Mucoepidermoid Ca	Intact	None
Lymphoma	-	ChT
Mucoepidermoid Ca	Intact	None
Mucoepidermoid Ca	Intact	None
Mucoepidermoid Ca	Intact	None
Mucoepidermoid Ca	Intact	None
Mucoepidermoid Ca	Intact	None
Sebaceous Ca	Intact	None
Ca ex pleomorphic adenoma	Intact	None
Mucoepidermoid Ca	Positive	RT
Malignant melanoma	Positive	ChT
Malignant melanoma	Positive	ChT
Ductal Ca	Positive	RT + ChT
Adenocystic Ca	Positive	Surgery*
Lymphoma	-	ChT
Metastases**	-	ChT
Metastases**	-	ChT

*Complementary parotidectomy + neck dissection.

Table 4. Comparison of DWI and FNAC, and histopathological findings in 26 patients that underwent DWI.

MRI with DWI	FNAC	Histopathology
Pleomorphic adenoma	Pleomorphic adenoma	Pleomorphic adenoma
Pleomorphic adenoma	Pleomorphic adenoma	Pleomorphic adenoma
Pleomorphic adenoma	Pleomorphic adenoma	Pleomorphic adenoma
Pleomorphic adenoma	Pleomorphic adenoma	Pleomorphic adenoma
Pleomorphic adenoma	Pleomorphic adenoma	Pleomorphic adenoma
Pleomorphic adenoma	Non-diagnostic	Pleomorphic adenoma
Pleomorphic adenoma	Non-diagnostic	Pleomorphic adenoma
Pleomorphic adenoma	Not existent	Pleomorphic adenoma
Pleomorphic adenoma	Myoepithelial carcinoma	Pleomorphic adenoma
Benign pathology	Pleomorphic adenoma	Pleomorphic adenoma
Benign pathology	Pleomorphic adenoma	Pleomorphic adenoma
Cyst	Pleomorphic adenoma	Pleomorphic adenoma
Sialadenitis	Non-diagnostic	Pleomorphic adenoma
Malignant pathology	Not existent	Pleomorphic adenoma
Warthin's tumor	Warthin's tumor	Warthin's tumor
Malignant pathology	Warthin's tumor	Warthin's tumor
Cyst	Not existent	Cyst
Benign pathology	Non-diagnostic	Cystadenoma
Benign pathology	Adenocystic ca	Adenoma
Sialadenitis	Sialadenitis	Sialadenitis
Benign pathology	Lymphoid cells	Lymphoid hyperplasia

In conclusion, FNAC and MRI with DWI were similarly valuable for specific histopathological diagnosis of parotid masses. Furthermore, MRI provides valuable information regarding the size and location of masses in addition to their relationship to surrounding structures. Surgery is the primary treatment modality for parotid tumors and the minimal surgical procedure should be partial parotidectomy. If surgery must be expanded, MRI greatly contributes to this decision-making process. In the present study FNAC did not aid surgical planning nor did they nor made a result in any changes to the surgical plan. Nevertheless, the decision to use FNAC should be left to surgeons.

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