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RESEARCH

Role of ultrasound in the assessment of benignity and malignancy of parotid masses

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Objectives: This study aimed to investigate the value of ultrasound in the identification of benign and malignant parotid masses.
Methods: Data of 189 patients with parotid gland masses undergoing ultrasound-guided fine-needle aspiration (FNA), core biopsy or surgery were reviewed retrospectively and the presumed sonographic diagnoses were compared with the histopathology. The sensitivity, specificity and accuracy of sonographic diagnoses were assessed and the sonographic characteristics of those lesions, including shape, margin, echogenicity, echotexture and vascularization, were studied.
Results: Of the 189 patients, the final pathological diagnosis included 18 malignant tumours and 171 benign masses; the presumed sonographic diagnoses showed 165 cases as benign and probably benign masses (11 cases were confirmed malignant, 154 cases benign) and 24 cases were diagnosed as probably malignant and malignant masses (7 cases were confirmed malignant, 17 cases benign). The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of ultrasound for the diagnosis of parotid gland masses were 38.9%, 90.1%, 29.2%, 93.3% and 85.2%, respectively, and accuracy for malignant masses was 20%. The sonographic characteristics of parotid masses between benign and malignant lesions had no significant differences. The parotid gland masses in this study included pleomorphic adenoma, Warthin's tumour, retention cyst, haemangiomas, chronic granuloma, lymphoma, fibrolipoma, abscess, basal cell adenoma, oncocytoma, lymphatic tuberculosis, myoepithelioma, neurilemmoma, mucoepidermoid carcinoma, adenoid cystic carcinoma, alveolar soft part sarcoma and retinal blastoma (metastasis).
Conclusions: It is challenging to use sonography for differentiating between benign and malignant parotid gland masses. To make a definite diagnosis, ultrasound-guided FNA or core biopsy is advocated.
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Keywords: parotid gland; mass; benign; malignant; ultrasound

Introduction

Parotid gland masses include benign tumours, malignant tumours and chronic inflammatory diseases. Identification of benign or malignant lesions is linked with management. Ultrasound plays an important role in the diagnosis of space-occupying lesions. Some studies[1–4] found that ultrasound was able to differentiate between benign and malignant parotid masses with high accuracy while other studies[5–9] presented opposing conclusions. The aim of this study was to assess the role of ultrasound in the evaluation of benignity and malignancy of parotid gland masses.

Materials and methods

The data of 189 patients (91 males, 98 females; average age 42.3 years; range, 1.5–76 years) who had undergone ultrasound-guided fine-needle aspiration (FNA) cytology, core biopsy or surgery between January 2005 and May 2010 were retrospectively reviewed. The data were obtained from Picture Archiving and

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Communication Systems of the Affiliated Hospital of Hainan Medical College, China, and the presumed sonographic diagnosis and sonographic characteristics were studied. The presumed sonographic diagnosis and ultrasound-guided FNA cytology or core biopsy were made at real time ultrasound imaging and the imaging study of parotid masses was done by experienced sonologists. The ultrasound systems used were Logiq 9 and Voluson 730 Expert (GE Healthcare Systems, Waukesha, WI) and HP5500, HD11 XE (HP Medical Systems, Dalian, China), and the frequency of the transducers was 10 MHz–12 MHz.

The sonographic characteristics were reviewed in consensus by two sonologists who had 9 years and 10 years' experience of parotid ultrasound examination, respectively, and who were blinded to the presumed and final diagnosis. The interpretation was based on individual ultrasound features of parotid gland masses with reference to reports[1–4,7] and was combined with our experience, including dimensions, shape (oval, lobulated or irregular), margins (circumscribed, spiculated or ill-defined), echogenicity (anechoic, hypoechoic, isoechoic or hyperechoic), echotexture (homogeneous or heterogeneous) and vascularization. Vascularization was assessed in four grades: Grade 1 indicates no vessels visible in the mass in colour Doppler flow imaging (CDFI) low-flow mode; Grade 2 indicates a few vessel segments of no more than three blood vessels visible in the whole mass; Grade 3 indicates up to five vessels visible in the mass; and Grade 4 indicates more than five vessels visible in the mass.

The sonographic characteristics suggesting probably malignant or malignant masses were irregular shape, spiculated or ill-defined margin, heterogeneous echotexture, punctate calcification and vascularization (Grade 3–4). The sonographic characteristics suggesting probably benign or benign mass were round or ovoid shape, circumscribed margin, homogeneous echotexture and vascularization (Grade 1–2).

The presumed sonographic diagnoses were categorized in regard to the above references. The analysis of sonographic characteristics associated with benign and malignant lesions was based on pathological diagnosis and the final diagnosis was based on the pathological confirmation of parotid masses which had undergone FNA cytology, biopsy or surgical resection.

Data analysis

Comparing the presumed sonographic diagnosis of parotid gland masses with the pathological results, the sensitivity, specificity, positive predictive value, negative predictive value and accuracy were determined. χ^2 tests were used for the analyses of ultrasound characteristics of benign and malignant masses and $p < 0.05$ was considered statistically significant. The software used was SPSS (Version 11.0, SPSS, Inc., an IBM Company, Chicago, IL).

This study was approved by our institutional review board with a waiver of informed consent.

Results

Of the 189 patients, the final pathological diagnosis included 18 malignant tumours and 171 benign masses. The presumed sonographic diagnoses showed 165 cases as benign and probably benign masses (143 cases were excised and 22 cases underwent FNA or core biopsy; 11 cases were confirmed malignant and 154 cases benign) while 24 cases were diagnosed as probably malignant and malignant masses (20 cases were excised and 4 cases underwent FNA or core biopsy; 7 cases were confirmed malignant and 17 cases benign).

The maximum dimension of benign and malignant masses was 26.4 mm ($\pm$7.4 mm) and 27.1 mm ($\pm$6.5 mm), respectively. Pathological classification and the numfber of parotid masses are shown in Table 1 and the sonographic characteristics of pathologically confirmed parotid masses are shown in Table 2 and illustrated on Figures 1–5. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of ultrasound for the diagnosis of parotid gland masses were 38.9%, 90.1%, 29.2%, 93.3% and 85.2%, respectively, and accuracy for malignant masses was 20%. 17 benign masses that were misdiagnosed as malignant masses were in fact lymphatic tuberculosis (Figure 5), pleomorphic adenoma and Warthin's tumour. 11 malignant masses that were misdiagnosed as benign masses were mucoepidermoid carcinoma (7 cases; Figure 4), metastasis of retinal blastoma (1 case), alveolar soft part sarcoma (1 case) and adenoid cystic carcinoma (2 cases).

Discussion

The parotid gland masses in this study included benign tumours, malignant tumours and inflammatory or lymphatic lesions; the majority were benign lesions and only a very small amount (9.5%) were malignant,

Table 1 Pathological classification and number of parotid masses

Pathological classification	*Number*
Pleomorphic adenoma	63
Warthin's tumour	47
Retention and simple cyst	8
Haemangioma	10
Granuloma	18
Lymphoma	4
Fibrolipoma	5
Abscess	2
Basal cell adenoma	3
Oncocytoma	4
Lymphatic tuberculosis	3
Myoepithelioma	3
Neurilemmoma	1
Mucoepidermoid carcinoma	13
Adenoid cystic carcinoma	3
Alveolar soft part sarcoma	1
Retinal blastoma (metastasis)	1

Table 2 Sonographic characteristics of pathologically confirmed parotid masses

Parameter		*Benign*	*Malignant*	p-*value*
Shape	Ovoid	108	12	> 0.05
	Lobulated	23	2	> 0.05
	Irregular	40	4	> 0.05
Margin	Circumscribed	158	15	> 0.05
	Spiculated	2	1	> 0.05
	Ill defined	11	2	> 0.05
Echogenicity	Anechoic	16	0	> 0.05
	Hypoechoic	149	18	> 0.05
	Isoechoic	6	0	> 0.05
Echotexture	Homogeneous	15	3	> 0.05
	Heterogeneous	156	15	> 0.05
	Calcification	20	3	> 0.05
Vascularization	0	62	5	> 0.05
	+	75	7	> 0.05
	++	20	3	> 0.05
	+++	14	3	> 0.05

0, grade 1 vascularization of the parotid masses; +, grade 2 vascularization of the parotid masses; ++, grade 3 vascularization of the parotid masses; +++, grade 4 vascularization of the parotid masses.

which was similar to some authors' findings.[10,11] However, the proportion of malignant lesions in our study was far less than in a report by Lin et al,[12] where out of 271 patients who underwent parotidectomy, 229 (85%) had benign tumours, 33 (12%) had malignant tumours and 9 had chronic inflammatory disease (3%). Our results were also lower than those of Mohammed et al[11] who studied 242 patients, of whom 183 (75.6%) had benign neoplasms, 51 (21.1%) had malignant neoplasms and 8 (3.3%) had inflammatory or lymphatic lesions, suggesting that parotid malignant tumours in our region were fewer than in other regions.

In this study, the most common benign parotid tumour was pleomorphic adenoma and the most frequent malignant tumour was mucoepidermoid carcinoma, which was consistent with some studies.[12–15] The results of the sensitivity, specificity, positive predictive value, negative predictive value and accuracy of ultrasound for the diagnosis of parotid gland masses and the accuracy for malignant masses indicated that the overall level of sonographic diagnosis, was low, which suggested that ultrasound examination was unable to make a sufficiently definite diagnosis, and this is in disagreement with some studies.[1–4] The sonographic characteristics of parotid masses including shape, margin, echogenicity, echotexture and vascularization between benign and malignant lesions had no

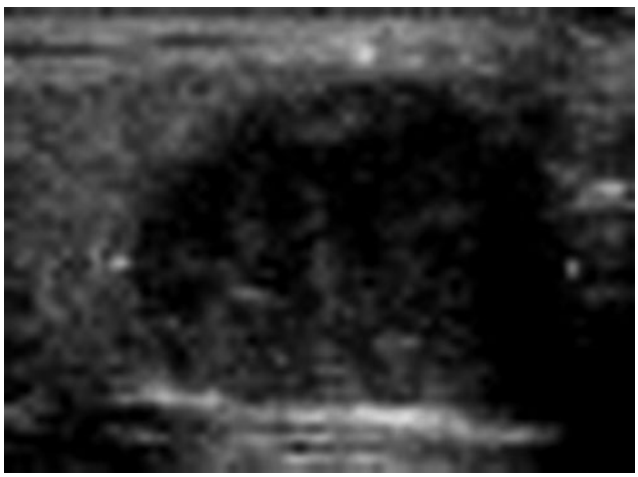

Figure 1 Sonographic image shows a heterogeneous hypoechoic ovoid mass in the left parotid in a 36-year-old male with well-defined margin, posterior echogenicity enhancement and mild edge refraction. The presumed diagnosis was benign lesion and the pathological diagnosis was pleomorphic adenoma

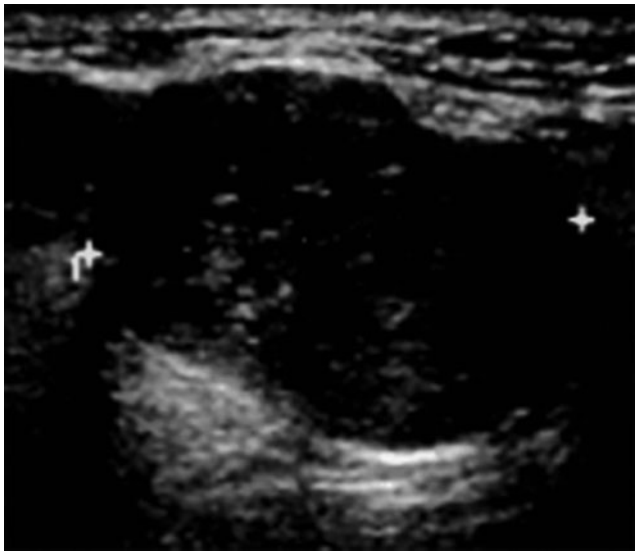

Figure 2 Sonographic image shows a heterogeneous hypoechoic ovoid mass in the left parotid in a 68-year-old female with punctate calcifications, circumscribed margin, posterior echogenicity enhancement and distinct edge refraction. The presumed diagnosis was benign lesion and the pathological diagnosis was Warthin's tumour

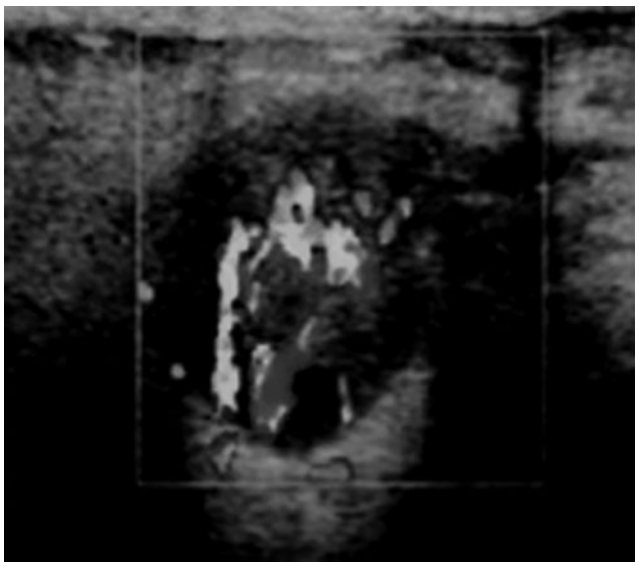

Figure 3 Sonographic image shows a heterogeneous hypoechoic ovoid mass in the right parotid in a 47-year-old male with circumscribed margin, posterior echogenicity enhancement, distinct edge refraction and much vascularization in colour Doppler imaging. The presumed diagnosis was probably benign lesion and the pathological diagnosis was oncocytoma

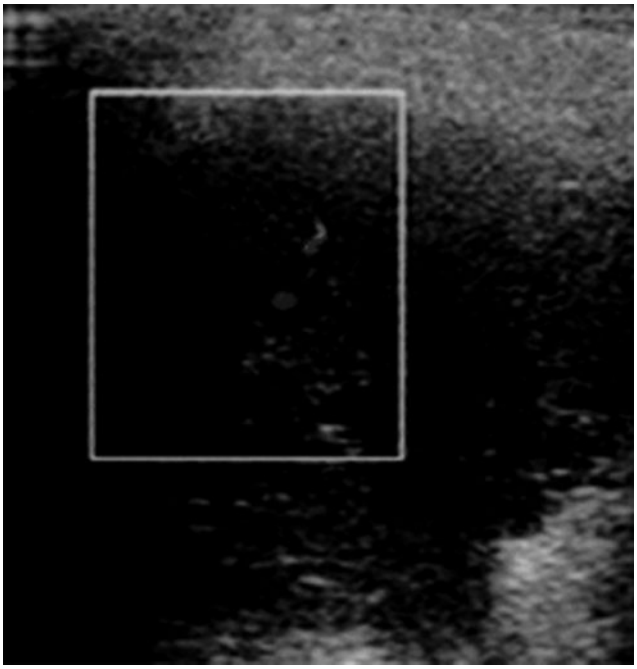

Figure 4 Sonographic image shows a heterogeneous hypoechoic lobulated mass in the left parotid in a 52-year-old female with circumscribed margin, posterior echogenicity enhancement, distinct edge refraction and fair vascularization in colour Doppler imaging. The presumed diagnosis was probably benign lesion and the pathological diagnosis was mucoepidermoid carcinoma

significant difference, which indicated that it is hard to distinguish malignant parotid masses from benign masses using sonography and that this method is unable to distinguish between different benign or malignant lesions because some tumours and lesions have similar characteristics.[1–4,16–18] This was in disagreement with other studies.[1–4,6,7] Sonographic features of infiltration of parotid malignant tumours were not found in this study and are seldom reported in other literature. CDFI may find parotid masses blood supply information, but the distribution in benign and malignant lesions had no significant difference and its value was limited, which was consistent with Bradley et al[8] and Schick et al.[9]

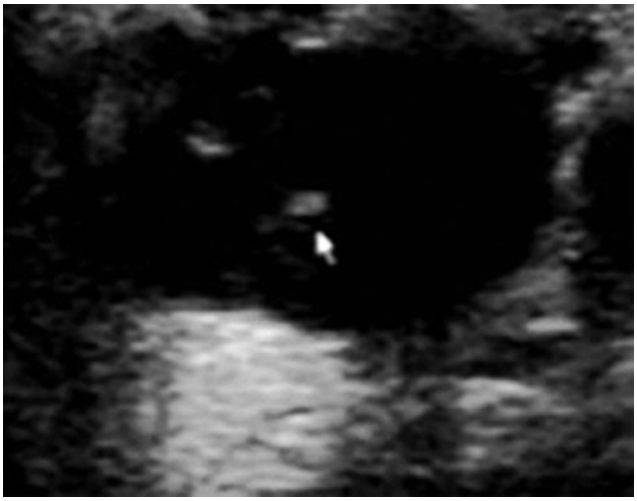

Figure 5 Sonographic image shows a heterogeneous hypoechoic ovoid mass in the right parotid in a 27-year-old male with punctate calcifications, well-defined margin, posterior echogenicity enhancement and distinct edge refraction. The presumed diagnosis was probably malignant lesion and the pathological diagnosis was lymphatic tuberculosis

The potential limitations of the study were that the sample size was not large enough, some small nodules and large size masses without FNA or pathological results were not included, a few cases did not undergo ultrasound examination and were not included, and the clinical data, including history, speed of growth, pain, facial palsy and so on, were not enrolled, which may affect the study of the parotid gland masses.

In conclusion, it is challenging to use ultrasound for the differentiation between benign and malignant parotid gland masses. To make a definite diagnosis, ultrasound-guided FNA cytology or core biopsy is advocated.

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