RESEARCH

Characteristic power Doppler sonographic images of tumorous and non-tumorous buccal space lesions

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Objectives: The aim of this study was to evaluate the characteristic power Doppler sonographic images of buccal space tumorous and non-tumorous lesions.

Methods: 48 patients with buccal space lesions were evaluated with greyscale sonography followed by power Doppler sonography with a 12 MHz linear transducer. On greyscale sonography, buccal space lesions were assessed for the boundary (clear or unclear), echogenicity (hypoechoic or isoechoic) and internal architecture (homogeneous or heterogeneous). Power Doppler sonography was performed to evaluate the vascular signals within the buccal space lesions.

Results: 48 lesions were found in the 48 patients; of these 48 lesions, 28 were tumorous and 20 were non-tumorous. In the 28 tumours, 15 cases showed clear boundaries, 15 cases were hypoechoic relative to adjacent tissues and 22 cases presented with a heterogeneous appearance on greyscale sonography. The internal vascularity of 19 tumours was shown using power Doppler sonography. In the 20 non-tumorous lesions, 11 cases showed clear boundaries, 17 cases were hypoechoic relative to adjacent tissues and 13 cases presented with a homogeneous appearance on greyscale sonography. 18 non-tumorous lesions showed no internal vascularity using power Doppler sonography. Logistic multivariate regression analysis between the tumour group and the non-tumorous lesions group demonstrated that the internal architecture (odds ratio = 8.270, $p = 0.029$) and vascular signals (odds ratio = 17.533, $p = 0.003$) were significant variables.

Conclusions: Power Doppler sonography is a useful technique for the differential diagnosis of tumorous and non-tumorous buccal space lesions.

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Keywords: buccal space; power Doppler sonography; ultrasonography

Introduction

The buccal space is a compartment that constitutes the substance of the cheek.¹ It is anatomically bounded by the buccinator muscle medially, the superficial layer of the deep cervical fascia and the muscles of facial expression laterally and anteriorly and the masticator space and the parotid gland posteriorly. Although a variety of lesions are known to occur in this space, their radiological features have not been well covered in the literature.^{2,3}

Ultrasonography has gained wide acceptance as a valuable diagnostic aid in the evaluation of head and neck lesions, such as lymph nodes of the neck,⁴⁻⁶ salivary gland disorders⁷⁻⁹ and the submandibular space.¹⁰⁻¹² Power Doppler sonography, with the advantages of less direction dependence, higher sensitivity and better contrast of vascular contour, is a favourable tool to study tissue and tumour vascularity.^{13,14} However, to our knowledge, reports on power Doppler sonography of buccal space lesions are very few.

The aim of this study was to evaluate the characteristic power Doppler sonographic images of buccal space tumorous and non-tumorous lesions.

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Table 1 Ultrasonographic appearances of the buccal space lesions

Histopathological diagnosis (number of cases)	Boundary		Echogenicity		Internal architecture		Vascular signals	
	Clear	Unclear	Hypoechoic	Isoechoic	Homogeneous	Heterogeneous	Presence	Absence
Tumours (28)	15 (53.6%)	13 (46.4%)	15 (53.6%)	13 (46.4%)	6 (21.4%)	22 (78.6%)	19 (67.9%)	9 (32.1%)
Haemangioma (20)	11	9	12	8	2	18	14	6
Lymphangioma (1)	1	0	0	1	1	0	1	0
Neurofibroma (1)	1	0	1	0	1	0	0	1
Lipoma (1)	0	1	0	1	0	1	0	1
Squamous cell carcinoma (1)	0	1	0	1	0	1	0	1
Acinic cell carcinoma (1)	0	1	0	1	0	1	1	0
Mucoepidermoid carcinoma (1)	1	0	0	1	0	1	1	0
Oncocytic carcinoma (1)	1	0	1	0	1	0	1	0
Lymphoma (1)	0	1	1	0	1	0	1	0
Non-tumorous lesions (20)	11 (55.0%)	9 (45.0%)	17 (85.0%)	3 (15.0%)	13 (65.0%)	7 (35.0%)	2 (10.0%)	18 (90.0%)
Inflammatory granulation tissue (11)	2	9	8	3	4	7	2	9
Mucous cyst (8)	8	0	8	0	8	0	0	8
Epidermoid cyst (1)	1	0	1	0	1	0	0	1

Materials and methods

48 patients with buccal space lesions were examined by ultrasonography in the Department of Radiology at our university hospital from November 2003 to May 2012. The patients comprised 27 males and 21 females with a mean age of 52.5 years (range 7–86 years). Informed consent was obtained from all patients. The histopathological diagnoses were obtained by surgery or biopsy in all cases. The 48 lesions were divided into 28 tumours (haemangioma, $n = 20$; lymphangioma, $n = 1$; neurofibroma, $n = 1$; lipoma, $n = 1$; squamous cell carcinoma, $n = 1$; acinic cell carcinoma, $n = 1$; mucoepidermoid carcinoma, $n = 1$; oncocytic carcinoma, $n = 1$; lymphoma, $n = 1$) and 20 non-tumorous lesions (inflammatory granulation tissue, $n = 11$; mucous cyst, $n = 8$; epidermoid cyst, $n = 1$), based on World Health Organization criteria.¹⁵

In each patient, buccal space lesions were evaluated with greyscale sonography followed by power Doppler sonography before surgical intervention. All ultrasonography examinations were performed with a 12 MHz linear transducer (NEMIO 30 SSA-550A; Toshiba Medical Systems, Tokyo, Japan). On greyscale sonography, buccal space lesions were assessed for the boundary (clear or unclear), echogenicity (hypoechoic or isoechoic) and internal architecture (homogeneous or heterogeneous). Power Doppler sonography was performed to evaluate the vascular signals within the buccal space lesions. All sonographic assessments were performed by the same investigator, who was unaware of the results of other diagnostic investigations. All images were evaluated by two oral radiologists, and any differences were resolved by forced consensus.

Kappa coefficients between the two oral radiologists were calculated for boundary, echogenicity, internal architecture and vascular signals. Statistical analyses for the comparison of ultrasonographic appearance of the buccal space lesions between the tumour group and the non-tumorous lesions group were performed using logistic multivariate regression analysis. The analyses were performed with the statistical package SPSS[®]

v. 14.0 (SPSS Japan Inc., Tokyo, Japan). $p < 0.05$ was considered to indicate statistical significance.

Results

Kappa coefficients between the two oral radiologists were 0.762 for boundary, 0.815 for echogenicity, 0.744 for internal architecture and 1.000 for vascular signals. Table 1 shows the ultrasonographic appearance of the buccal space lesions. In the 28 tumours, 15 cases showed clear boundaries, 15 cases were hypoechoic relative to the adjacent tissues and 22 cases presented with a heterogeneous appearance on greyscale sonography. The internal vascularity of 19 tumours was shown using power Doppler sonography. Figure 1 shows the ultrasonogram of a haemangioma as the typical power Doppler sonographic characteristics of a buccal space tumour. Figure 2 shows the ultrasonogram of a mucoepidermoid carcinoma.

In the 20 non-tumorous lesions, 11 cases showed clear boundaries, 17 cases were hypoechoic relative to the adjacent tissues and 13 cases presented with a homogeneous appearance on greyscale sonography. 18 non-tumorous lesions showed no internal vascularity using power Doppler sonography. Figure 3 shows the ultrasonogram of an inflammatory granulation as the typical power Doppler sonographic characteristics of a buccal space non-tumorous lesion. Figure 4 shows the ultrasonogram of an epidermoid cyst.

Table 2 shows the logistic multivariate regression analysis between tumorous and non-tumorous buccal space lesions. The analysis between the tumour group and the non-tumorous lesions group demonstrates that the internal architecture (odds ratio = 8.270, $p = 0.029$) and vascular signals (odds ratio = 17.533, $p = 0.003$) were significant variables.

Discussion

We evaluated the power Doppler sonographic characteristics of lesions originating in the buccal space. In this

Figure 1 Ultrasonogram of a haemangioma of the right buccal space in a 68-year-old female. The lesion showed clear boundaries and was hypoechoic and homogeneous with vascular signals within the lesion

study, the most common tumours of the buccal space were a haemangioma, followed by a minor salivary gland tumour, and the most common non-tumorous lesions of the buccal space were inflammatory granulation tissue

followed by a cyst. The greater part of the buccal space is filled by adipose tissue, which is termed the buccal fat pad.¹ The other contents include the parotid duct, minor salivary glands, accessory parotid lobules, the facial and

Figure 2 Ultrasonogram of a mucoepidermoid carcinoma of the left buccal space in a 49-year-old male. The lesion showed clear boundaries and was isoechoic with a hypoechoic appearance and was heterogeneous with vascular signals within the lesion

Figure 3 Ultrasonogram of an inflammatory granulation tissue of the right buccal space in a 56-year-old female. The lesion showed unclear boundaries and was hypoechoic and heterogeneous without vascular signals within the lesion

buccal artery, the facial vein, lymphatic channels and the branches of the facial and mandibular nerve. Inflammatory lesions originating in this space are common in odontogenic infection.¹⁶ Therefore, we consider that the

differential diagnosis of a buccal space lesion includes a tumour originating from glandular, vascular, lymphatic, connective, muscular, ductal and neural tissues, an odontogenic infection or a cyst.

Figure 4 Ultrasonogram of an epidermoid cyst of the right buccal space in a 71-year-old female. The lesion showed clear boundaries and was hypoechoic and homogeneous without vascular signals within the lesion

Table 2 Logistic multivariate regression analysis between tumorous and non-tumorous buccal space lesions

Ultrasonography findings	Odds ratio	95% CI	p-value
Boundary	0.386	0.066–2.249	0.290
Echogenicity	1.290	0.203–8.185	0.787
Internal architecture	8.270	1.246–54.897	0.029
Vascular signals	17.533	2.586–118.890	0.003

CI, confidence interval.

In the present study, there was a significant difference in the internal architecture (homogeneous or heterogeneous) and the vascular signals using power Doppler sonography between the tumour group and the non-tumorous lesions group in the buccal space. This is in agreement with previous studies. For the internal architecture, Wu et al⁹ indicated that 92.1% of tumours in the parotid gland were heterogeneous. Chandak et al¹¹ indicated that 63.0% of tumours in the head and neck were heterogeneous. In this study, 78.6% tumours in the buccal space were heterogeneous. For the internal vascularity, Wu et al⁹ indicated that 64.6% of tumours in the parotid gland showed internal vascular signals. In this study, 67.9% of tumours in the buccal space showed internal vascular signals. We consider that power Doppler sonography can be a useful technique for the differential diagnosis of buccal space tumours. Wu et al⁹ used sonography for differentiating between benign and malignant parotid gland masses. We did not analyse the

differentiation between benign and malignant tumours in the buccal space because the number of malignant tumours was small in this study. We consider that the differentiation between benign and malignant tumours in the buccal space is important for future studies using power Doppler sonography.

Kurabayashi et al^{2,3} showed that CT and MRI were useful in demonstrating the presence and location of masses in the buccal space and sometimes in the differential diagnosis. Compared with these two methods, power Doppler sonography is quick, easy, cost-effective and, with the use of high-frequency transducers, more suitable for imaging superficial structures, especially when it is difficult to differentiate the mass from the adjacent tissues in the oral and maxillofacial region. We consider that power Doppler sonography is the best initial investigation technique for the evaluation of buccal space lesions and quite a useful technique for the pre-operative evaluation of patients with small buccal tumours. When a buccal tumour is large or is suspected of being malignant, comparative evaluations by CT and/or MRI are recommended.

In conclusion, this study suggests that the power Doppler sonographic characteristics of buccal space tumours are a heterogeneous appearance with vascular signals, and that power Doppler sonography can be a useful technique for the differential diagnosis of buccal space tumours.

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