MRI findings of mucoepidermoid carcinoma of the parotid gland: correlation with pathological features

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Objective: The aim of this study was to correlate the MRI appearance and pathological findings in each grade of the mucoepidermoid carcinoma (MEC) of the parotid gland.

Methods: We reviewed surgically proven MECs of parotid glands in 20 patients. Pathologically, 5 tumours were high-grade, 3 were intermediate and 12 were low-grade. MR images were evaluated with emphasis on signal intensities on T_2 weighted images, margin characteristics and lymph node metastasis, correlating these with pathological features.

Results: Among the high-grade MECs, four out of five tumours showed inhomogeneous low to intermediate signal intensity on T_2 weighted images, reflecting high cellularity. All tumours had an ill-defined margin, reflecting invasive tumour growth. Among the intermediate-grade MECs, all three tumours showed intermediate signal intensity on T_2 weighted images and two tumours had an ill-defined margin. Among the low-grade MECs, 11 of the 12 tumours had a hyperintense area on T_2 weighted images because of the existence of abundant mucin secreting cells. Seven tumours had an ill-defined margin, reflecting peritumoural inflammatory changes rather than invasive tumour growth. Lymph node metastasis was seen in three high-grade MECs.

Conclusion: MECs of the parotid gland show variable MRI findings reflecting their histological nature, which seems to have certain tendencies depending on the tumour grade.

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Mucoepidermoid carcinoma (MEC) is the most common malignancy of the salivary gland, accounting for 3–15% of all salivary gland tumours. Their most favoured site is the parotid gland, which accounts for over 80% of MECs [1–4]. Histologically, MEC has been classified as low, intermediate or high grade according to intracystic components, mitotic figures, neural invasion, necrosis and cellular anaplasia. This histological grading has been reported as correlating with clinical behaviour [1–4]. Although clinical and pathological features of MEC have been well described, radiological features of MEC have not been systematically reported. In this study, we delineate MRI findings in each grade of MEC and correlate these with histological findings.

Methods and materials

20 patients with MEC of the parotid gland who underwent MR examination before resection between 2002 and 2009 were reviewed. There were 9 males and 11 females with an age range of 13–83 years (mean 60 years). The histological grades were classified on the basis of the well-known criteria proposed by Goode et al [1] and were as follows: 5 tumours were high grade, 3 were intermediate and 12 were low grade. MR images were obtained using a 1.5-T machine (Symphony, Siemens, Erlangen, Germany; Signa, GE Healthcare, Milwaukee, WI) in 17 patients and a 3-T machine (Trio, Siemens) in 3 patients. In all patients, transverse T_1 weighted spin-echo (SE) images (repetition time/echo time (TR/TE) 466–680 ms/14–20 ms) and T_2 weighted fast SE images (TR/TE 2500–5200 ms/80–120 ms) were obtained. In some cases, transverse fat-suppressed T_2 weighted, coronal T_1 weighted or fat-suppressed T_2 weighted images were obtained. In 11 cases, post-contrast transverse and coronal T_1 weighted images

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Table 1 Histological grade and MRI findings

Case number	Age (years)/sex	Histological grade	Presence of hyperintense area on T_2 WI	Margin characteristics	Lymphadenopathy
1	68/F	High	None	Ill defined	No
2	41/M	High	Present	Ill defined	No
3	77/M	High	None	Ill defined	Yes
4	29/M	High	None	Ill defined	Yes
5	83/F	High	None	Ill defined	Yes
6	51/F	Intermediate	None	Ill defined	No
7	27/M	Intermediate	None	Well defined	No
8	60/M	Intermediate	None	Ill defined	No
9	18/M	Low	Present	Well defined	No
10	71/F	Low	Present	Well defined	No
11	34/F	Low	Present	Ill defined	No
12	27/F	Low	Present	Ill defined	No
13	57/F	Low	Present	Ill defined	No
14	72/M	Low	Present	Ill defined	No
15	29/F	Low	Present	Well defined	No
16	48/F	Low	Present	Ill defined	No
17	59/F	Low	None	Ill defined	No
18	78/F	Low	Present	Ill defined	No
19	57/F	Low	Present	Well defined	No
20	13/F	Low	Present	Well defined	No

F, female; M, male; T_2 WI, T_2 weighted images.

were acquired with or without a fat-suppression technique. Section thickness was 4–6 mm and pixel size was 0.4×0.7 mm– 1.0×1.0 mm.

Two experienced radiologist (KN and YA) investigated the MRI findings with an emphasis on the presence of hyperintense areas on T_2 weighted images, boundary definition and the presence of lymph node metastasis. The signal intensity was defined in relation to muscle and fat. Low signal intensity was defined as less than that of muscle, intermediate signal intensity was greater than or equal to that of muscle but less than that of fat and high signal intensity was greater or equal to that of fat. Boundary definition was classified as well defined or ill defined. The lymph node was defined as pathological when it had a minimal axial diameter of >10 mm or central necrosis. Consensus was always obtained in cases of discrepancy between the readers. An experienced radiologist (NK) and pathologists correlated the MR images and pathology.

Results

The patient characteristics, histological grading and MRI findings are summarised in Table 1. Among high-grade MECs, all five tumours showed inhomogeneous low to intermediate signal intensity on T_2 weighted images (Figure 1a) and only one tumour had a small hyperintense area on T_2 weighted images. All five tumours had an ill-defined margin (Figure 1b). Regarding pathological correlation, tumours had predominant epidermoid cells and a lack of mucous cells and their products, resulting in solid architectural pattern (Figure 1c), and infiltrative growth of tumour cells with or without capsulation was seen (Figure 1d). Three of the five tumours had pathological lymph nodes, all of

which were confirmed on pathological examination as metastatic lymph nodes. Among intermediate-grade MECs, all three tumours had intermediate signal intensity on T_2 weighted images (Figure 2a). One tumour had a well-defined margin (Figure 2b) and the other two had an ill-defined margin. Pathological examination showed an increased number of mucous cells (Figure 2c). Regarding pathological correlation, the former showed a fibrous capsule surrounding the tumour (Figure 2d) and the later showed infiltrative tumour growth. None had a pathological lymph node. Among low-grade MECs, 11 out of 12 tumours had a hyperintense area on T_2 weighted images (Figure 3a). Five tumours had a well-defined margin and seven tumours had an ill-defined margin (Figure 3b,c). Pathologically, low-grade tumours had abundant mucous cells with their products, resulting in a cystic architectural pattern (Figure 3d). Upon pathological correlation, the well-defined margin reflects the fibrous capsule of the tumour. Tumours with an ill-defined margin also had a fibrous capsule surrounding them. However, infiltration of inflammatory cells outside of the capsule was seen (Figure 3e). None had a pathological lymph node.

Discussion

MEC of the salivary gland is believed to arise from pluripotent reserve cells of the excretory ducts and this tumour comprised three different cell types: mucinous, intermediate and epidermoid. As a result of this cellular heterogeneity, MECs have a wide range of histological features and are classified as high, intermediate or low grade. This grading reportedly correlates with the clinical behaviour of the tumours [1–4]. Although

Figure 1. An 83-year-old female with a high-grade mucoepidermoid carcinoma (Case 5). (a) Axial T_2 weighted image shows a lobulated mass with inhomogeneous low to intermediate signal intensity. (b) Axial T_1 weighted image shows an ill-defined margin. (c) Microscopic examination of a central area shows a proliferation of spindle-shaped cells with a high nucleus-to-cytoplasm ratio. This high cellularity seems to contribute to the low to intermediate signal intensity on T_2 weighted images (haematoxylin and eosin staining, $\times 100$). (d) Microscopic examination of a peripheral area shows infiltrative growth of the tumour cells (arrows) without capsulation (haematoxylin and eosin staining, $\times 100$).

fine-needle biopsy is a useful and minimally invasive adjunct in the diagnosis of parotid gland tumours, it is often difficult to differentiate between benignity and malignancy or to establish tumour grades because of insufficient specimens, sampling errors and the subjective opinion of the cytopathologist [2, 5]. Therefore pre-operative imaging has an important role in surgical planning.

In our study, the small number of patients makes a statistically significant correlation difficult. Nevertheless, the MRI findings seem to have a tendency to be related to

the histological grade. Among high-grade MECs, although non-specific, the tumours showed MRI findings suggesting high-grade malignancies [6–9]; low to intermediate signal intensities on T_2 weighted images reflect high-cellularity, the ill-defined margin reflects the invasive growth of tumour cells and the frequent nodal metastasis reflects a propensity of lymphatic involvement.

MRI features of intermediate-grade MECs showed a combination of those of low- and high-grade MECs; however, further study with a larger number of intermediate-grade MECs is needed for better characterisation.

(a)

(b)

(c)

(d)

Figure 2. A 27-year-old male with an intermediate-grade mucoepidermoid carcinoma (MEC) (Case 7). (a) Axial T_2 weighted image shows a mass with intermediate signal intensity. (b) Axial T_1 weighted image shows a well-defined margin. (c) Microscopic examination of a central area shows an admixture of mucus cells and epidermoid cells. The cellularity is lower compared with that of high-grade MECs (haematoxylin and eosin staining, $\times 100$). (d) Microscopic examination of a peripheral area shows fibrous capsule (arrows) between the tumour and normal parotid gland (haematoxylin and eosin staining, $\times 100$).

Among low-grade MECs, tumours usually had a hyperintense area on T_2 weighted images, reflecting a cystic architectural pattern because of the existence of abundant mucin-secreting cells. A similar tendency of increased signal intensity on T_2 weighted images in lower-grade malignancies was reported for adenoid cystic carcinomas of the head and neck region [10]. In contrast with the previous literature that describes ill-defined margins on MR images as a predictor of high-grade malignancies [6–9], half of our low-grade MECs had ill-defined margins on MR images, reflecting peritumoural

inflammatory changes. This peritumoural reactive inflammation in low-grade MECs has also been described in the pathology literature [2, 11]; however, our study is the first to present this radiologically. This may be because previous studies of MECs included only a small number of patients with low-grade MECs, ranging from one to four patients per study [6–9]. In contrast, our study is the first to radiologically evaluate more than ten cases of low-grade MECs. Therefore, for the MECs of the parotid glands, a diagnosis of high-grade MECs should not be concluded based solely on an ill-defined margin on MR images.

Figure 3. A 48-year-old female with a low-grade mucoepidermoid carcinoma (Case 16). (a) On T_2 weighted image, the lateral component of the mass shows marked high signal intensity, suggesting a cystic portion. (b) On T_1 weighted image, the medial margin of the tumour is ill-defined. (c) Post-contrast fat-suppressed T_1 weighted image shows an ill-defined margin. (d) Microscopic examination shows a large cavity corresponding to the cystic area on MR images. The arrows indicate secreted mucinous materials (haematoxylin and eosin staining, $\times 100$). (e) On microscopic examination of a peripheral area, although a fibrous capsule exists, infiltration of inflammatory cells (arrows) is seen outside of the capsule, which seems to cause the ill-defined margin on MR images (haematoxylin and eosin staining, $\times 100$).

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