Salivary duct carcinoma with rhabdoid features: Report of 2 cases with immunohistochemical and ultrastructural analyses

Kimihide Kusafuka, DDS, PhD,[1*] Tetsuro Onitsuka, MD, PhD,[2] Koji Muramatsu, PA,[1] Tomoko Miki, MD,[1] Chika Murai, DDS,[3] Toshihito Suda, MD,[2] Tomohito Fuke, MD,[2] Tomoyuki Kamijo, MD, PhD,[2] Yoshiyuki Iida, MD,[2] Takashi Nakajima, MD, PhD[1]

[1]Pathology Division, Shizuoka Cancer Center, Shizuoka, Japan, [2]Division of Head and Neck Surgery, Shizuoka Cancer Center, Shizuoka, Japan, [3]Division of Oral Surgery, Shizuoka Cancer Center, Shizuoka, Japan.

Accepted 13 August 2013
Published online 22 August 2013 in Wiley Online Library (wileyonlinelibrary.com). DOI 10.1002/hed.23466

ABSTRACT: *Background.* Salivary duct carcinoma with rhabdoid features is extremely rare.

Methods. We report 2 cases of salivary duct carcinoma with rhabdoid features treated at our institution.

Results. Case 1 was a 44-year-old Japanese man who had swelling in the left parotid region. This tumor consisted of residual pleomorphic adenoma and widely invasive carcinoma, which showed a diffuse growth pattern by atypical rhabdoid cells. Case 2 was a 66-year-old Japanese man who had swelling of the right cervical region. This submandibular tumor was also composed of both residual pleomorphic adenoma region and invasive adenocarcinoma components, whereas some metastatic lesions were purely composed of rhabdoid cells. Such cells were strongly and diffusely positive for cytokeratins (CKs), gross cystic disease fluid protein-15 (GCDFP), and androgen receptor (AR). Case 1 was also positive for Her-2 and p53.

Conclusion. Both patients were diagnosed with carcinoma ex pleomorphic adenoma and their carcinomatous components were composed of salivary duct carcinoma with rhabdoid features, which is a highly aggressive tumor, similar to salivary duct carcinoma. © 2013 The Authors. Head & Neck published by Wiley Periodicals, Inc. *Head Neck* 36: E28–E35, 2014

KEY WORDS: salivary duct carcinoma, rhabdoid cells, carcinoma ex pleomorphic adenoma, immunohistochemistry, ultrastructure

INTRODUCTION

Salivary duct carcinoma is a high-grade neoplasm known to histologically resemble high-grade ductal carcinoma of the breast,[1] and includes several variants, for example, sarcomatoid,[2–4] invasive micropapillary,[5] mucin-rich,[6–8] and low-grade[9–11] variants. Among such salivary duct carcinoma variants, sarcomatoid salivary duct carcinoma is extremely rare.[2,3] Henley et al[2] were the first to report 3 cases of sarcomatoid salivary duct carcinoma. Previously reported cases, which were diagnosed as carcinosarcoma of the salivary glands, may include sarcomatoid salivary duct carcinoma cases.[12–18]

Rhabdoid cells have been seen in several neoplasms in other organs, including renal tumor,[19] brain tumor,[20] gastric carcinoma,[21,22] lung carcinoma,[23] and breast carcinoma.[24] In salivary gland neoplasms, however, such cells are not seen frequently. Nagao et al[3] reported on 8 cases of sarcomatoid salivary duct carcinoma and, in their report, only 1 case was composed of rhabdoid cells as sarcomatoid components of sarcomatoid salivary duct carcinoma.

We report 2 cases of salivary duct carcinoma with rhabdoid features as carcinomatous components of carcinoma ex pleomorphic adenoma of major salivary glands that were examined immunohistochemically. Written informed consent was obtained from the patients for publication of this case report and any accompanying images.

*Corresponding author: K. Kusafuka, Pathology Division, Shizuoka Cancer Center, 1007 Shimonagakubo, Nagaizumi-cho, Sunto-gun, Shizuoka 411-8777, Japan. E-mail: k.kusafuka@scchr.jp

CASE REPORTS

Case 1: Clinical findings

The patient was a 44-year-old Japanese man who had been suffering from swelling of the left parotid region. The left neck also began to show swelling. He was admitted to our hospital 9 years later. On MRI scan, a 40 × 42 × 70 mm irregularly shaped mass with low intensity on T1 and T2 resonance imaging was seen in the left parotid gland (Figure 1A). Total parotidectomy was performed under the clinical diagnosis of parotid gland carcinoma (cT4aN2bM0). After the operation, radiotherapy (60 Gy) was performed but, after 8 months, multiple bone metastases were found.

Case 1: Pathological findings

Macroscopically, case 1 showed an ill-defined grayish-white mass in the left parotid gland. A whitish elastic-hard nodule was seen in this main mass (Figure 2A).

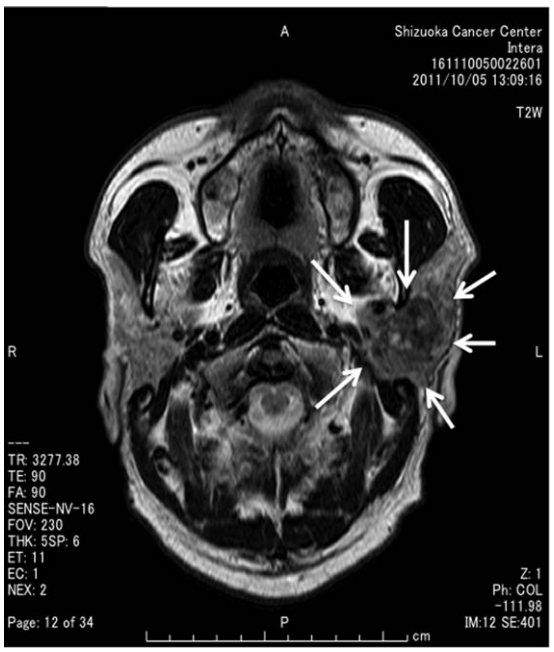

FIGURE 1. MR image revealed an irregular-shaped mass with low intensity in the left parotid gland (white arrows) with T2 resonance imaging (case 1).

Histologically, the nodule showed hyalinized stroma with a few spindle cells, which showed marked elastosis with Elastica van Gieson stain and, partly, myxoid stroma with spindle or stellate-shaped myoepithelial cells. This nodule was considered residual pleomorphic adenoma (Figure 2B). In the peripheral transitional area, atypical ductal cells with eosinophilic cytoplasm were observed, which were similar to salivary duct carcinoma cells (Figure 2C). The main tumor was a widely invasive carcinoma, which consisted of the diffuse proliferation of rhabdoid cells with ovoid eosinophilic cytoplasm, eccentric nuclei, marked cellular atypia, and 1 or 2 large nucleoli (Figure 2D). Such rhabdoid cells were nonadhesive. Although approximately 3% of the tumor consisted of the cribriform pattern growth of atypical ductal cells, which was considered to be salivary duct carcinoma, 97% of the tumor was composed of atypical rhabdoid cells. In the periphery of pleomorphic adenoma, a transitional zone was observed between them (Figure 2E). Numerous lymph node metastases were also seen histologically, and these metastatic tumors were composed of atypical rhabdoid cells, similar to those of the primary tumor.

Case 2: Clinical findings

The patient was a 66-year-old Japanese man who had been suffering from swelling of the right neck region. He was admitted to our hospital 3 months later and, clinically, this cervical lesion was diagnosed as metastatic carcinoma of unknown origin. MRI indicated an approximately 50 × 50 × 50 mm mass with low intensity on T1 imaging and partially high intensity on T2 imaging in the right submandibular regions and multiple lymph node metastases. At the first clinical examination, a 30 × 30 mm metastatic nodule was found in the right upper lobe of the lung on CT, and upper digestive endoscopic examination indicated early gastric cancer, which consisted of an erosive lesion. Right neck dissection was performed under the clinical diagnosis of metastatic tumor of unknown origin (cTxN2bM1). He has been followed up for 6 months with lung metastasis. Gastric cancer has been followed up until the present without any treatment.

Case 2: Pathological findings

Macroscopically, case 2 showed an ill-defined grayish-white mass with markedly cystic change in the right submandibular gland. A yellowish elastic-hard nodule was seen in this main mass (Figure 3A and 3B).

Histologically, the main tumor arose from the submandibular gland, and, in a widely invasive area, the carcinoma component showed a solid and/or large nest growth pattern with marked cellular atypia and central necrosis (Figure 3C). The nodule, which showed hyalinized stroma, indicated marked elastosis with Elastica van Gieson stain. In the peripheral area, the carcinoma cells formed irregular-shaped nests with intracellular lumens. Ten lymph node metastases were found histologically; 6 metastatic lesions showed solid growth patterns, similar to the primary carcinoma, whereas 4 lesions showed noncoherent rhabdoid cells with eosinophilic cytoplasm, eccentric nuclei, and marked cellular atypia (Figure 3D). The proportion of such rhabdoid cells was approximately 40% in the metastatic lesions, although no component of rhabdoid cells was seen in the primary tumor.

The biopsy specimen of the gastric lesion was diagnosed as the conventional type of well-differentiated tubular adenocarcinoma.

Immunohistochemical analysis (case 1 and 2)

Immunohistochemical examination was performed with an Autostainer (DakoCytomation, Dako, Carpinteria, CA). Antibodies used in this study and their results are summarized in Table 1. We used Image J (National Institutes of Health, Bethesda, MD) to estimate the percentage of Ki-67-positive tumor cell rates.

In both cases, rhabdoid cells showed diffuse positivity for pan-cytokeratin (CK), CK7, epithelial membrane antigen (EMA), gross cystic disease fluid protein (GCDFP)-15, and androgen receptor (AR; Figure 4A–4C). Moreover, such cells in case 1 were positive for Her-2, prostate-specific antigen (PSA), and p53 (Figure 4D and 4E). Although the primary carcinoma in case 2 was negative for GCDFP-15, AR, Her-2, and PSA, both this component and the rhabdoid component were strongly positive for p16.

The Ki-67 labeling index was high in both rhabdoid cell components (43.2% and 94.5% in case 1 and 2, respectively; Figure 4F), although residual pleomorphic adenoma components in both cases were very low (5.1% and 0.4% in case 1 and 2, respectively). Regarding mucin molecules, rhabdoid cells were positive for MUC1, MUC6, and CA125, especially in case 2.

In both cases, the spindle cells in the nodules were positive for α-smooth muscle actin (ASMA), calponin, CK14, vimentin, and S-100 protein; therefore, these cells

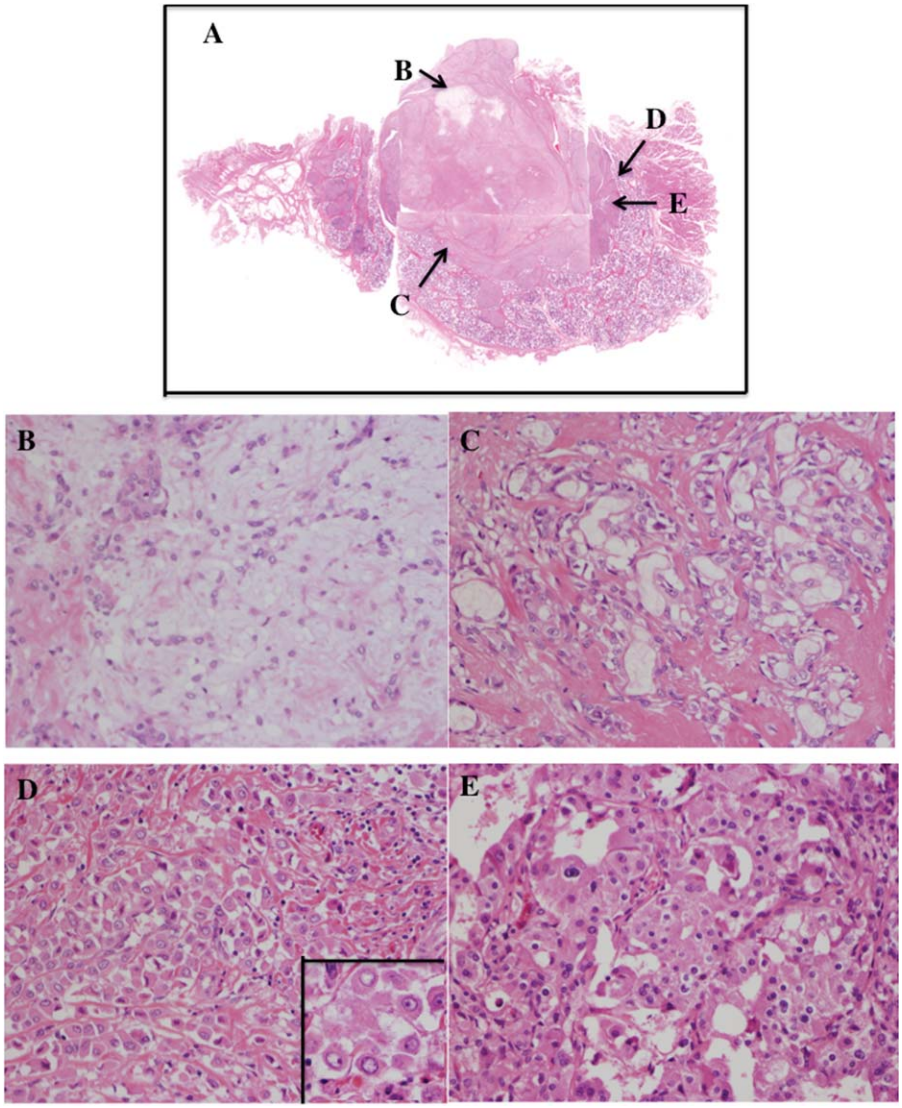

FIGURE 2. Histological findings of case 1. (A) The tumor showed a hyalinized nodule in the central area and an invasive component around it (whole mount hematoxylin-eosin stained section). (B) Part of the hyalinized nodule (B area in A: hematoxylin-eosin stain: original magnification ×200) showed spindle-shaped neoplastic myoepithelial cells in the myxoid stroma, which showed the typical histology of pleomorphic adenoma. (C) Atypical ductal carcinoma in situ component (C area in A: hematoxylin-eosin stain: original magnification ×200) was observed in the peripheral portion of pleomorphic adenoma. (D) Invasive component (D area in A: hematoxylin-eosin stain: original magnification ×200) showed the diffuse growth of noncoherent, ovoid-shaped, carcinoma cells. (D: inset: hematoxylin-eosin stain: original magnification ×400) Carcinoma cells showed eccentric nuclei, marked cellular atypia and 1 large nucleolus with eosinophilic cytoplasm. (E) Typical histology of salivary duct carcinoma, which consisted of irregular-shaped atypical glands with eosinophilic cytoplasm, relatively large cytoplasm and marked nuclear atypia, was seen at the invasive component (E area in A: hematoxylin-eosin stain: original magnification ×200).

were neoplastic myoepithelial cells and this nodule was considered to be preexisting pleomorphic adenoma. In case 1, the inner atypical ductal cells in the transitional area were positive for GCDFP-15, AR, Her-2, pan-CK, and EMA (Figure 5A), whereas the spindle cells around such ductal cells were positive for ASMA, calponin, CK14, p63, and S-100 protein (Figure 5B); therefore, this lesion was considered as an in situ component of salivary duct carcinoma. The invasive component of the primary tumor in case 2 showed positivity for pan-CK and EMA, and focal positivity for epidermal growth factor receptor (EGFR) and p63. This lesion was considered adenocarcinoma, not otherwise specified (NOS).

Rhabdoid cells in both cases were negative for all myoepithelial markers, such as ASMA, calponin, CK14, p63, and S-100 protein.

We finally diagnosed case 1 as "salivary duct carcinoma with rhabdoid features ex pleomorphic adenoma" and case 2 as "poorly differentiated adenocarcinoma, NOS, carcinoma ex pleomorphic adenoma" and "metastatic salivary duct carcinoma with rhabdoid features and adenocarcinoma in the cervical lymph nodes."

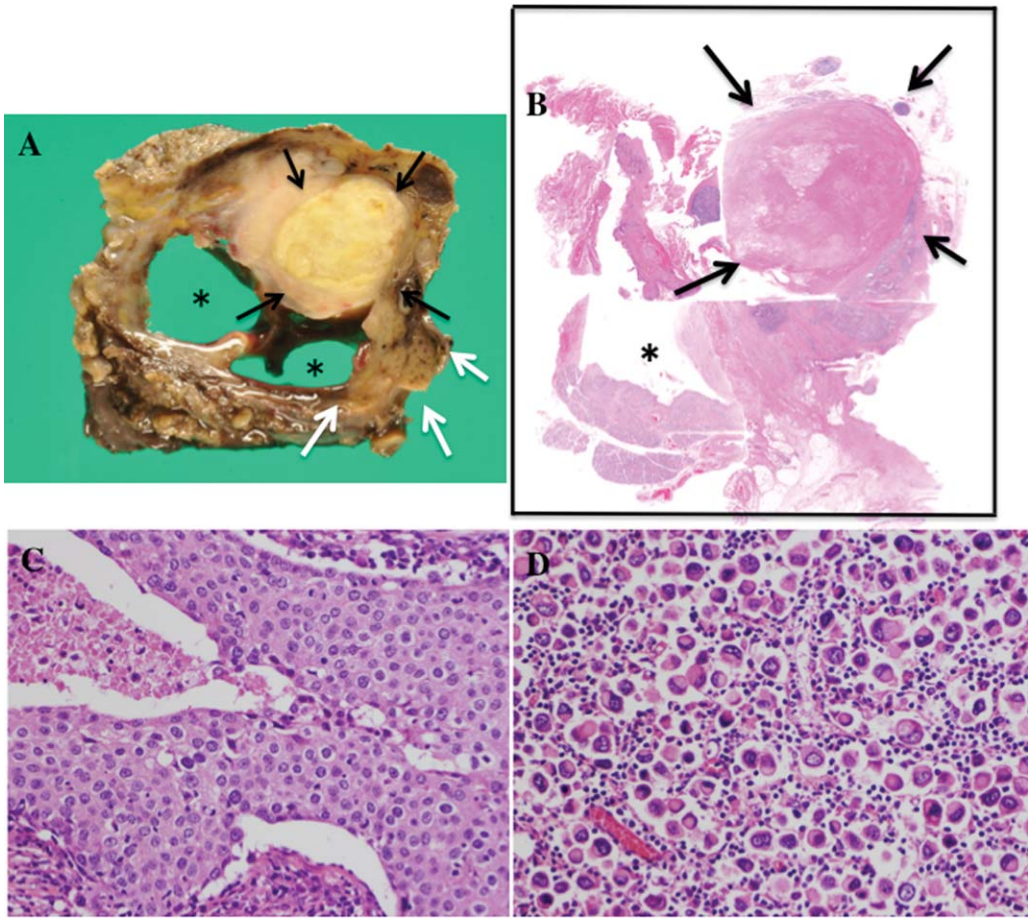

FIGURE 3. Pathological findings of case 2. (A) Macroscopically, the main tumor showed cystic change (asterisks) and included a yellowish nodule (black arrows). The tumor expanded from the right submandibular gland (white arrows). (B) Low magnification view of histology indicated a hyalinized nodule, which was a preexisting pleomorphic adenoma (arrows), and the invasive component around the nodule, which was accompanied with cystic change (asterisk; whole mount hematoxylin-eosin stain section). (C) Invasive component showed sheet-like growth of adenocarcinoma cells with central necrosis (hematoxylin-eosin stain: original magnification ×200). (D) Part of the metastatic lesions showed diffuse proliferation of rhabdoid cells, which were similar to those of case 1 (hematoxylin-eosin stain: original magnification ×200).

By electron microscope, tumor cells were variably sized, ovoid, or cuboidal. Tumor cells contained the condensation of intermediate filaments, dilated segments of rough endoplasmic reticulum, and mitochondria (Figure 6). Tumor cells frequently lacked the adherence junction and tight junction. The nuclei of tumor cells frequently showed irregular shapes with dense nuclear membranes.

DISCUSSION

Conventional salivary duct carcinoma histologically mimics ductal carcinoma of the breast with a high nuclear grade and a solid, cribriform, or papillary type.[1] In 2000, Henley et al[2] reported 3 cases of salivary duct carcinoma that contained malignant spindle cell elements; the authors designated these neoplasms "sarcomatoid salivary duct carcinoma." In 2004, Nagao et al[3] reported 8 cases of sarcomatoid salivary duct carcinoma, and they used the term sarcomatoid salivary duct carcinoma to designate biphasic neoplasms with or without heterologous differentiation, provided that the carcinomatous components fulfilled the criteria for conventional salivary duct carcinoma. Nineteen sarcomatoid salivary duct carcinoma cases have been reported in the literature.[2–4,25] Previous cases diagnosed as "carcinosarcoma" or "sarcomatoid carcinoma" might have been sarcomatoid salivary duct carcinoma.[3,12–18,25] Usually, sarcomatoid salivary duct carcinoma consists of both malignant epithelial cells and malignant spindle cells, whereas Nagao et al[3] proposed that sarcomatoid salivary duct carcinoma is composed of both epithelial and mesenchymal components, which contain heterologous elements, such as osteosarcomatous, chondrosarcomatous, giant cell tumor–like, and rhabdoid tumor-like elements. In their report, only 1 case that contained rhabdoid cells was described with 1 figure; therefore, to the best of our knowledge, the present cases are the second to be reported. Histologically, both of our cases showed diffuse proliferation of rhabdoid cells, which were loosely adhesive with relatively large eosinophilic cytoplasm, eccentric nuclei, marked cellular atypia, and 1 or 2 large nucleoli. The metastatic lesions in case 2 consisted of adenocarcinoma, NOS components, and

TABLE 1. Antibodies used in this study and their results.

Antigen	Clone	P/M	Source	Case 1		Case 2		
				PA	SDCRF	PA	SDCRF	AdC
pan-CK	AE-1/3	M	Signet Laboratories (Denham, MA, USA)	(myo)+	++	(myo)+	++	++
EMA	E29	M	Progen Biotechnik (Geiderberg, Germany)	−	++	−	++	++
CK7	OV-TL-12/30	M	DakoCytomation (Carpinteria, CA, USA)	−	++	−	++	++
LMWK	CAM5.2	M	Becton Dickinson (San Jose, CA, USA)	(myo)f+	++	−	++	++
CK14	LL002	M	Chemicon International (Temecula, CA, USA)	(myo)+	−	(myo)f+	−	−
CK5/6	D5/16B4	M	DakoCytomation (Carpinteria, CA, USA)	(myo)+	−	(myo)f+	−	−
p63	4A4	M	LAB Vision (Fremont, CA, USA)	(myo)f+	−	−	−	f+
calponin	CALP	M	DakoCytomation (Carpinteria, CA, USA)	(myo)+	−	(myo)f+	N.D.	−
S-100 protein		P	DakoCytomation (Carpinteria, CA, USA)	(myo)+	−	−	−	−
vimentin	V9	M	DakoCytomation (Carpinteria, CA, USA)	(myo)+	−	(myo)+	−	f+
GCDFP-15	NCL-GCDFP-15	M	Novocastra Laboratories (Newcastle upon Tyne, UK)	−	++	−	++	−
AR	AR441	M	DakoCytomation (Carpinteria, CA, USA)	−	++	−	++	−
ER	SP-1	M	Thermo Scientific (Fremint, CA, USA)	−	−	−	−	−
PgR	1A6	M	Novocastra Laboratories (Newcastle upon Tyne, UK)	−	−	−	−	−
Her-2		P	DakoCytomation (Carpinteria, CA, USA)	−	2+	−	−	−
EGFR	NCL-L-EGFR	M	Novocastra Laboratories (Newcastle upon Tyne, UK)	f+	−	−	−	f+
PSA		P	DakoCytomation (Carpinteria, CA, USA)	−	+	−	−	−
CEA	CEM10	M	TeKaRa Bio (Shiga, Japan)	f+	−	−	p+	−
CA125	OC125	M	DakoCytomation (Carpinteria, CA, USA)	p+	f+	−	++	++
CA19-9	116NS199	M	DakoCytomation (Carpinteria, CA, USA)	p+	f+	−	−	−
MUC1	NCL-Mab695MUC1	M	Novocastra Laboratories (Newcastle upon Tyne, UK)	(SDC)p+	+	−	++	p+
MUC2	NCL-CLP58MUC2	M	Novocastra Laboratories (Newcastle upon Tyne, UK)	−	−	−	f+	−
MUC4	1G8	M	Santa Cruz Biotechnology (Santa Cruz, CA, USA)	−	−	−	−	−
MUC5AC	CLH2MUC%AC	M	Novocastra Laboratories (Newcastle upon Tyne, UK)	(SDC)f+	−	−	p+	−
MUC5B		P	Santa Cruz Biotechnology (Santa Cruz, CA, USA)	−	−	−	−	−
MUC6	CLH5MUC6	M	Novocastra Laboratories (Newcastle upon Tyne, UK)	(SDC)p+	f+	−	+	−
p16	484	M	DakoCytomation (Carpinteria, CA, USA)	N.D.	N.D.	−	++	++
p53	DO-7	M	DakoCytomation (Carpinteria, CA, USA)	f+	+	−	−	w+
Ki-67	MIB-1	M	DakoCytomation (Carpinteria, CA, USA)	5.1%	43.2%	0.4%	94.2%	93.2%

Abbreviations: PA, pleomorphic adenoma; SDCRF, salivary duct carcinoma with rhabdoid feature; AdC, adenocarcinoma, not otherwise specified; CK, cytokeratin; LMWK, low-molecular-weight keratin; EMA, epithelial membrane antigen; GCDFP, gross cystic disease fluid protein; AR, androgen receptor; ER, estrogen receptor; PgR, progesterone receptor; EGFR, epidermal growth factor receptor; PSA, prostate-specific antigen; CEA, carcinoembryonic antigen; CA, carbohydrate antigen; -, negative; f+, focally positive; p+, partially positive; +, positive; ++, diffusely and strongly positive; (myo), myoepithelial cells.

rhabdoid cell components, although the primary lesion showed poorly differentiated adenocarcinoma, NOS; therefore, we considered that the transformation to salivary duct carcinoma with rhabdoid features occurred in the metastatic lesions. The mesenchymal elements of sarcomatoid salivary duct carcinoma usually show the dense proliferation of atypical spindle cells and are focally immunopositive for CK or EMA and diffusely positive for vimentin,[2,3] although the carcinomatous elements are positive for CKs, EMA, GCDFP-15, and AR, and case by case, positive for Her-2 and p53, similar to conventional salivary duct carcinoma.[26] Both of our cases were positive for CKs, EMA, GCDFP-15, and AR. Case 1 was also positive for Her-2, p53 and PSA, whereas case 2 was negative for Her-2 and p53, but strongly and diffusely positive for p16 and focally positive for EGFR. The salivary duct carcinoma with rhabdoid features should be diagnosed not only from the histology of both typical salivary duct carcinoma cells and rhabdoid cells, but also from an immunohistochemical examination for salivary duct carcinoma markers such as AR, GCDFP-15, and/or Her-2.

Six of the 19 sarcomatoid salivary duct carcinoma cases (32%) reported in the literature arose from a preexisting pleomorphic adenoma.[2,3,12–18] These occurrence rates are higher than those reported (up to 14%) for conventional salivary duct carcinomas in the review by Barnes et al[27] salivary duct carcinomas arising in a preexisting pleomorphic adenoma might be more prone to undergo sarcomatoid change than de novo salivary duct carcinomas; however, as only a small number of cases have been examined, additional case studies are necessary to determine whether this is true. On the other hand, the carcinomatous elements of carcinoma ex pleomorphic adenoma showed immunopositivity for AR of 50% to 100%,[28–30] and such elements in carcinoma ex pleomorphic adenoma might show salivary duct carcinoma–like features, especially in in situ lesions in pleomorphic adenoma. In our cases, case 1 had an in situ lesion, which was similar to high-grade ductal carcinoma in situ of the breast: the ductal component, which was positive for GCDFP-15 and AR, was circumscribed by neoplastic myoepithelial cells of residual pleomorphic adenoma.[28–30]

Salivary duct carcinoma with rhabdoid features must be distinguished from several other neoplasms. The differential diagnosis includes collision tumors and hybrid carcinomas.[31,32] Collision tumors are the fusion of 2 malignant neoplasms arising from independent topographic sites and they lack a transitional zone, which is commonly found in sarcomatoid salivary duct carcinoma.[31] In our cases,

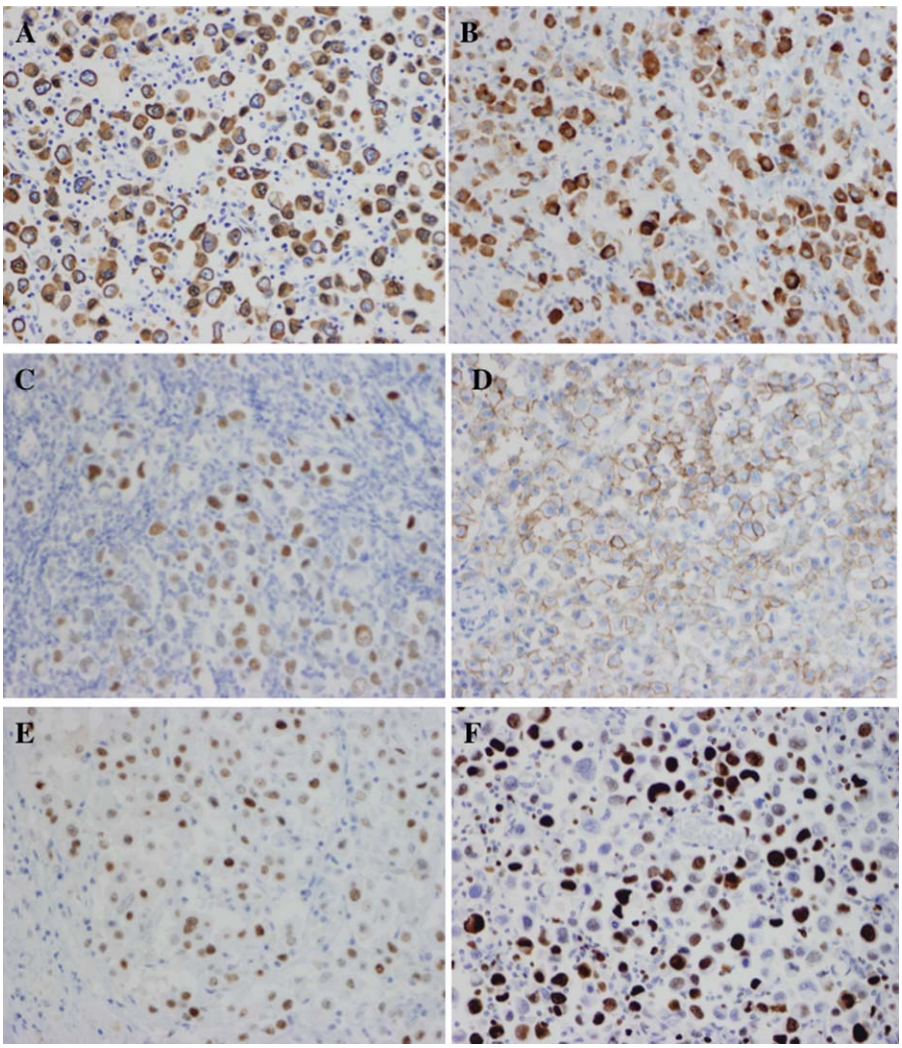

FIGURE 4. Immunohistochemical results for rhabdoid cells in both cases. Rhabdoid cells were positive for pan-cytokeratin (CK) (A: case 2: immunostaining: original magnification ×200), gross cystic disease fluid protein-15 (GCDFP-15). (B: case 1: immunostaining ×200) androgen receptor (AR) (C: case 2: immunostaining: original magnification ×200). They were positive for Her-2 (D: immunostaining: original magnification ×200) and p53 (E: immunostaining: original magnification ×200) in case 1. They were also diffusely positive for Ki-67 in case 2 (F: immunostaining: original magnification ×200).

case 2 lacked the transitional zone in metastatic lesions, but these lesions were entirely different from metastasis from gastric cancer. A hybrid carcinoma consisting of salivary duct carcinoma and myoepithelial carcinoma has been reported rarely.[32] Myoepithelial carcinoma can exhibit spindle cell morphologic features, whereas the hyaline type of myoepithelial carcinoma frequently shows plasmacytoid features[33]; therefore, this tumor should be distinguished from salivary duct carcinoma with rhabdoid features. However, myoepithelial carcinoma is usually positive for ASMA, calponin, p63, and S-100 protein,[33] but is usually negative for GCDFP-15 and AR and/or Her-2. Plasmacytoid cells are frequently seen in pleomorphic adenoma and myoepithelioma, but these cells in such tumors lack cellular atypia, such as large and irregular-shaped cytoplasm, marked nuclear atypia, and marked swelling of nucleoli. Moreover, plasmacytoid cells are positive for myoepithelial markers,[34,35] but negative for GCDFP-15, AR, and/or Her-2, which are markers of salivary duct carcinoma. Metastatic tumors from distant sites should be distinguished from salivary duct carcinoma with rhabdoid features. Malignant rhabdoid tumors arising from the kidney[19] and brain[20] are positive for vimentin, whereas gastric,[21,22] lung,[23] and breast carcinomas[24] with rhabdoid cells are also positive for both vimentin and CK. In our cases, the carcinoma cells were positive for CK but not vimentin, so they were not exactly "rhabdoid cells"; therefore, we diagnosed them as salivary duct carcinoma cells with rhabdoid features. Although the patient in case 2 also had gastric cancer, this lesion was histologically conventional differentiated adenocarcinoma, different from the metastatic lesions seen in the cervical lymph nodes.

Histologically, salivary duct carcinoma with rhabdoid features is also similar to nonepithelial tumors, such as malignant lymphoma, malignant melanoma, and rhabdomyosarcoma, because of the features of noncohesive cells,

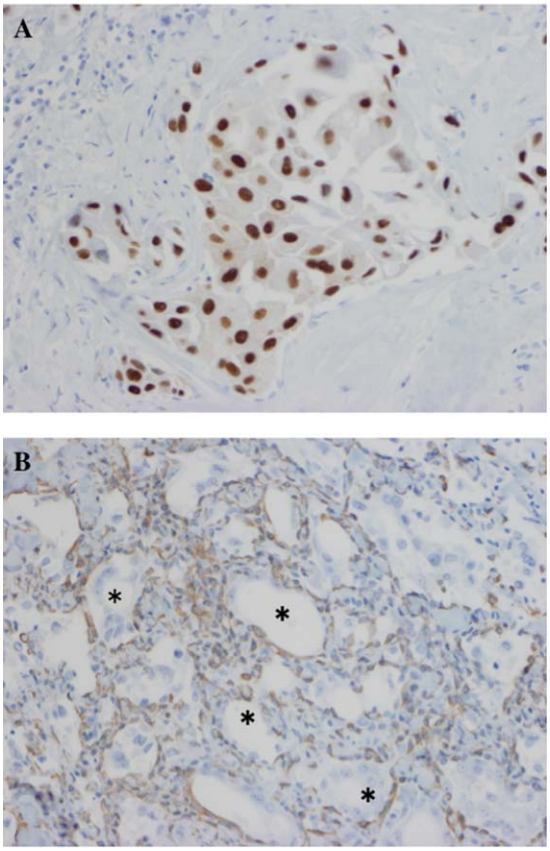

FIGURE 5. Immunohistochemical findings of in situ lesion in case 1. In the peripheral area of the residual pleomorphic adenoma, the inner atypical ductal cells were positive for androgen receptor (AR) (A: immunostaining: original magnification ×200) and the neoplastic myoepithelial cells around the atypical ductal cells (asterisks) were positive for cytokeratin (CK)14 (B: immunostaining: original magnification ×200).

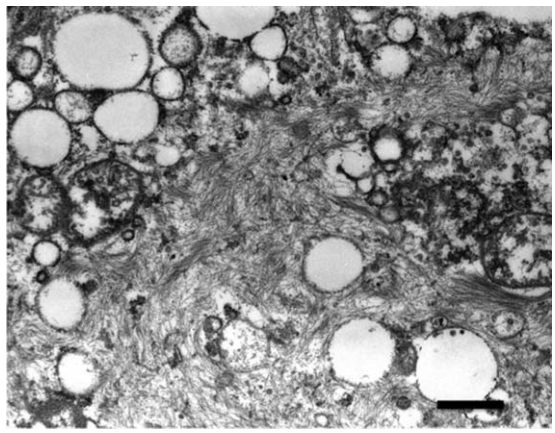

FIGURE 6. Ultrastructural finding of case 1. The condensation of the intermediated filaments and dilated segments of rough endoplasm reticulum were frequently observed in tumor cell cytoplasm. Scale bar = 1 μm.

when such a tumor is seen in metastatic lesions. However, salivary duct carcinoma with rhabdoid features cells were negative for lymphoma markers, such as CD45 (leukocyte common antigen), CD20, CD5, and/or CD30 (data not shown). They were also negative for melanoma markers, such as S-100 protein, HMB45, or Melan-A, and for skeletal muscle markers such as myogenin, myoD1, and desmin (data not shown); therefore, salivary duct carcinoma with rhabdoid features should be distinguished from malignant lymphoma, malignant melanoma, and myogenic sarcomas.

In the 19 sarcomatoid salivary duct carcinoma cases, this neoplasm affected 12 men and 7 women, who had a mean age of 63.4 years (range, 37–86 years).[2,3,13–18] The tumors developed preferentially in major salivary glands, especially the parotid glands. Among sarcomatoid salivary duct carcinoma cases and even salivary duct carcinoma cases that have been already reported, only 1 case showed salivary duct carcinoma with rhabdoid features.[3] Even in other salivary gland carcinomas, there has been no description that the tumor cells showed rhabdoid features. One case of salivary duct carcinoma with rhabdoid features, which was reported by Nagao et al,[3] showed no evidence of disease 18 months after initial diagnosis and had no preexisting pleomorphic adenoma. Our patients are alive with disease and both cases arose from preexisting pleomorphic adenoma; therefore, the outcome and origin of salivary duct carcinoma with rhabdoid features remain unclear.

In conclusion, salivary duct carcinoma with rhabdoid features as a carcinomatous element of carcinoma ex pleomorphic adenoma is exceedingly rare. Immunohistochemically, rhabdoid cells were positive for GCDFP-15, AR, CKs, and EMA, which were useful markers for the diagnosis of salivary duct carcinoma with rhabdoid features.

Acknowledgments

The authors thank Mr. Isamu Hayashi, Mr. Yoichi Watanabe, Ms. Sachiyo Oono, Ms. Kaori Nagata, Mr. Hiroshi Tashiro, Mr. Masatake Honda, Mr. Masato Abe, Ms. Chiho Tashiro, Mr. Takuya Kawasaki, Mr. Masatsugu Abe, Mr. Shogo Fuji, Ms. Kyoko Tanaka, and Ms. Kazumi Yamamoto, the staff of the Pathology Division, Shizuoka Cancer Center, Shizuoka, Japan, for excellent technical assistance. We are also grateful to Ms. Minako Ishii, secretariat of the Pathology Division, Shizuoka Cancer Center, Shizuoka, Japan, for her valuable help in the preparation of this manuscript. We also thank Mr. Daniel Mrozek, Medical English Service, Kyoto, Japan, for his excellent edit of this manuscript as a native English speaker.

REFERENCES

1. Brandwein–Gensler MS, Skalova A, Nagao T. Salivary duct carcinoma. In: Barnes EL, Eveson JW, Reichart P, Sidransky D, editors. Tumours of the salivary glands. World Health Organization classification of the tumours: pathology and genetics of the head and neck tumours. Lyon, France: IARC Press; 2005. pp 246–237.
2. Henley JD, Seo IS, Dayan D, Gnepp DR. Sarcomatoid salivary duct carcinoma of the parotid gland. *Hum Pathol* 2000;31:208–213.
3. Nagao T, Gaffey TA, Serizawa H, et al. Sarcomatoid variant of salivary duct carcinoma: clinicopathologic and immunohistochemical study of eight cases with review of the literature. *Am J Clin Pathol* 2004; 122:222–231.

4. Padberg BC, Sasse B, Huber A, Pfaltz M. Sarcomatoid salivary duct carcinoma. *Ann Diagn Pathol* 2005;9:86–92.
5. Nagao T, Gaffey TA, Visscher DW, et al. Invasive micropapillary salivary duct carcinoma: a distinct histologic variant with biologic significance. *Am J Surg Pathol* 2004;28:319–326.
6. Simpson RH, Prasad AR, Lewis JE, Skálová A, David L. Mucin-rich variant of salivary duct carcinoma: a clinicopathologic and immunohistochemical study of four cases. *Am J Surg Pathol* 2003;27:1070–1079.
7. Henley J, Summerlin DJ, Potter D, Tomich C. Intraoral mucin-rich salivary duct carcinoma. *Histopathology* 2005;47:436–437.
8. Kusafuka K, Nakamura S, Asano R, et al. Osteoclast-type giant cell tumor of minor salivary gland with mucin-rich salivary duct carcinoma: a case report of unusual histology with immunohistochemical analysis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2010;109:870–877.
9. Brandwein–Gensler M, Hille J, Wang BY, et al. Low-grade salivary duct carcinoma: description of 16 cases. *Am J Surg Pathol* 2004;28:1040–1044.
10. Weinreb I, Tabanda–Lichauco R, Van der Kwast T, Perez–Ordoñez B. Low-grade intraductal carcinoma of salivary gland: report of 3 cases with marked apocrine differentiation. *Am J Surg Pathol* 2006;30:1014–1021.
11. Kusafuka K, Ito H, Sugiyama C, Nakajima T. Low-grade salivary duct carcinoma of the parotid gland: report of a case with immunohistochemical analysis. *Med Mol Morphol* 2010;43:178–184.
12. Talmi YP, Halpren M, Finkelstein Y, Gal R, Zohar Y. True malignant mixed tumour of the parotid gland. *J Laryngol Otol* 1990;104:360–361.
13. Bleiweiss IJ, Huvos AG, Lara J, Strong EW. Carcinosarcoma of the submandibular gland: immunohistochemical findings. *Cancer* 1992;69:2031–2035.
14. Grenko RT, Tytor M, Boeryd B. Giant-cell tumour of the salivary gland with associated carcinosarcoma. *Histopathology* 1993;23:594–595.
15. Carson HJ, Tojo DP, Chow JM, Hammadeh R, Raslan WF. Carcinosarcoma of salivary glands with unusual stromal components: report of two cases and review of the literature. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1995;79:738–746.
16. Alvarez–Cañas C, Rodilla IG. True malignant mixed tumor (carcinosarcoma) of the parotid gland. Report of a case with immunohistochemical study. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1996;81:454–458.
17. Sironi M, Isimbaldi G, Claren R, Delpiano C, Di Nuovo F, Spinelli M. Carcinosarcoma of the parotid gland: cytological, clinicopathological and immunohistochemical study of a case. *Pathol Res Pract* 2000;196:511–517.
18. Pang PC, To EW, Tsang WM, Liu TL. Carcinosarcoma (malignant mixed tumor) of the parotid gland: a case report. *J Oral Maxillofac Surg* 2001;59:583–587.
19. Vujanić GM, Sandstedt B, Harms D, Boccon–Gibod L, Delemarre JF. Rhabdoid tumour of the kidney: a clinicopathological study of 22 patients from the International Society of Paediatric Oncology (SIOP) nephroblastoma file. *Histopatholgy* 1996;28:333–340.
20. Chau SM, Anderson JS. Primary CNS malignant rhabdoid tumor (MRT): report of two cases and review of literature. *Clin Neuropathol* 1991;10:1–10.
21. Shomori K, Sugamura K, Adachi K, Shiomi T, Nanba E, Ito H. Gastric adenocarcinoma with rhabdoid morphology. *Gastric Cancer* 2011;14:290–294.
22. Ueyama T. Nagai E, Yao T, Tsuneyoshi M. Vimentin-positive gastric carcinomas with rhabdoid features. A clinicopathologic and immunohistochemical study. *Am J Surg Pathol* 1993;17:813–819.
23. Tamboli P, Toprani TH, Amin MB, et al. Carcinoma of lung with rhabdoid features. *Hum Pathol* 2004;35:8–13.
24. Ohtake H, Iwaba A, Kato T, et al. Myoepithelial carcinoma of the breast with focal rhabdoid features. *Breast J* 2013;19:100–103.
25. Ide F, Mishima K, Saito I. Sarcomatoid salivary duct carcinoma of the oral cavity. *Virchows Arch* 2003;443:686–689.
26. Jaehne M, Roeser K, Jaekel T, Schepers JD, Albert N, Löning T. Clinical and immunohistologic typing of salivary duct carcinoma: a report of 50 cases. *Cancer* 2005;103:2526–2533.
27. Barnes L, Rao U, Krause J, Contis L, Schwartz A, Scalamogna P. Salivary duct carcinoma. Part I. A clinicopathologic evaluation and DNA image analysis of 13 cases with review of the literature. *Oral Surg Oral Med Oral Pathol* 1994;78:64–73.
28. Matsubayashi S, Yoshihara T. Carcinoma ex pleomorphic adenoma of the salivary gland: an immunohistochemical study. *Eur Arch Otorhinolaryngol* 2007;264:789–795.
29. Nakajima Y, Kishimoto T, Nagai Y, et al. Expressions of androgen receptor and its co-regulators in carcinoma ex pleomorphic adenoma of salivary gland. *Pathology* 2009;41:634–639.
30. Nasser SM, Faquin WC, Dayal Y. Expression of androgen, estrogen, and progesterone receptors in salivary gland tumors. Frequent expression of androgen receptor in a subset of malignant salivary gland tumors. *Am J Clin Pathol* 2003;119:801–806.
31. Nagao T, Sugano I, Ishida Y, et al. Hybrid carcinomas of the salivary glands: report of nine cases with a clinicopathologic, immunohistochemical, and p53 gene alteration analysis. *Mod Pathol* 2002;15:724–733.
32. Nagao T, Sugano I, Ishida Y, et al. Salivary gland malignant myoepithelioma: a clinicopathologic and immunohistochemical study of ten cases. *Cancer* 1998;83:1292–1299.
33. Savera AT, Slomon A, Huvos AG, Klimstra DS. Myoepithelial carcinoma of the salivary glands: a clinicopathologic study of 25 patients. *Am J Surg Pathol* 2000;24:761–774.
34. Takai Y, Dardick I, Mackay A, Burford–Mason A, Mori M. Diagnostic criteria for neoplastic myoepithelial cells in pleomorphic adenomas and myoepitheliomas. Immunocytochemical detection of muscle-specific actin, cytokeratin 14, vimentin, and glial fibrillary acidic protein. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1995;79:330–341.
35. Cuadra Zelaya F, Quezada Rivera D, Tapia Vazquez JL, Paez Valencia C, Gaitán Cepeda LA. Plasmacytoid myoepithelioma of the palate. Report of one cases and review of the literature. *Med Oral Pathol Oral Cir Bucal* 2007;12:E552–E555.