MR Findings of Nine Cases of Palatal Tumor

Fumiaki Ueda1*, Masayuki Suzuki2, Osamu Matsui1, Hiroshi Minato3, and Mitsuru Furukawa4

1Department of Radiology, Kanazawa University School of Medicine
13-1, Takara-machi, Kanazawa 920-8641, Japan
2Department of Radiological Technology, Kanazawa University School of Health Science
3Pathology Section, Kanazawa University Hospital
4Department of Otolaryngology, Kanazawa University School of Medicine

(Received June 27, 2005; Accepted September 7, 2005)

Purpose: To assess the magnetic resonance imaging (MRI) findings of pathologically confirmed palatal tumors.

Methods: Nine cases of palatal tumor were studied. Clinical data, MRI findings, and pathological diagnoses were evaluated.

Results: Five cases were tumors of the hard palate and four of the soft palate. Signal intensity on T1-weighted images varied, and hyperintensity was observed on T2-weighted images. Adenoid cystic carcinoma and diffuse large B cell lymphoma showed homogeneous signal intensity. Other tumors showed heterogeneous signal intensities. On dynamic contrast analysis, malignant pleomorphic adenoma, adenoid cystic carcinoma, diffuse large B cell lymphoma, and peripheral T cell lymphoma showed early enhancement. On post-contrast T1-weighted images, hard palate pleomorphic adenoma, malignant pleomorphic adenoma, adenoid cystic carcinoma, diffuse large B cell lymphoma, and peripheral T cell lymphoma showed strong enhancement. Although the borders of the tumors were classified as clear in 6 cases treated surgically, macroscopic and microscopic borders of the tumors were unclear. Adenoid cystic carcinoma and hard palate diffuse large B cell lymphoma invaded the maxillary bone.

Conclusion: Magnetic resonance imaging findings of palatal tumor varied in different histologies. Even with a small palpable portion, malignant tumors could directly infiltrate surrounding structures, which demonstrated well on MRI.

Keywords: magnetic resonance imaging, palate, tumor

Introduction

Many histological types of benign and malignant neoplasms can occur in the palate. Moreover, by the time a tumor in the palate is palpable, the malignancy has reached an advanced stage. Malignant tumors occur more frequently in the minor salivary glands than in the major salivary glands.1-4 High malignancy rates of palatal salivary gland tumors are reported.3,4 Moreover, as functional repair is very important, the surgical margin tends to be inadequate if a preoperative diagnosis of a benign tumor is made. As a result, local recurrence or distant metastasis may occur.

Magnetic resonance imaging (MRI) is the most valuable diagnostic modality to evaluate palatal tumors. The purpose of the present study was to assess the clinical data and MRI findings of both hard and soft palate tumors.

Patients and Methods

Nine pathologically diagnosed palatal tumors were evaluated retrospectively. Patients included 4 men and 5 female patients from 8 to 85 years old. Clinical data, MRI findings, and pathological findings were reviewed.

A General Electric 1.5-tesla MRI system was used (Signa Horizon or Signa Echo speed). The following images were obtained: sagittal, axial, and conventional spin echo (SE) T1-weighted images.
<table>
<thead>
<tr>
<th>No.</th>
<th>Age</th>
<th>Sex</th>
<th>First symptom</th>
<th>Location</th>
<th>SI on T1WI</th>
<th>SI on T2WI</th>
<th>Size (mm)</th>
<th>Character</th>
<th>CE effect</th>
<th>Margin</th>
<th>Lymphadenopathy</th>
<th>Pathology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>48</td>
<td>F</td>
<td>mass palpation</td>
<td>rt HP</td>
<td>hypo</td>
<td>hyper</td>
<td>20</td>
<td>hetero</td>
<td>not performed</td>
<td>clear</td>
<td>negative</td>
<td>pleomorphic adenoma</td>
</tr>
<tr>
<td>2</td>
<td>42</td>
<td>F</td>
<td>mass palpation</td>
<td>rt SP</td>
<td>hypo</td>
<td>hyper</td>
<td>15</td>
<td>hetero</td>
<td>prolonged</td>
<td>moderate</td>
<td>negative</td>
<td>malignant pleomorphic adenoma</td>
</tr>
<tr>
<td>3</td>
<td>62</td>
<td>F</td>
<td>epistaxis</td>
<td>rt HP</td>
<td>iso</td>
<td>hyper</td>
<td>40</td>
<td>hetero</td>
<td>early</td>
<td>strong</td>
<td>positive</td>
<td>squamous cell carcinoma</td>
</tr>
<tr>
<td>4</td>
<td>85</td>
<td>M</td>
<td>pain</td>
<td>lt SP</td>
<td>hypo</td>
<td>hyper</td>
<td>60</td>
<td>homo</td>
<td>early</td>
<td>strong</td>
<td>not performed</td>
<td>adenoid cystic carcinoma</td>
</tr>
<tr>
<td>5</td>
<td>74</td>
<td>F</td>
<td>mass palpation</td>
<td>lt HP</td>
<td>hypo</td>
<td>hyper</td>
<td>12</td>
<td>hetero</td>
<td>early</td>
<td>strong</td>
<td>negative</td>
<td>lymphoid cancer</td>
</tr>
<tr>
<td>6</td>
<td>68</td>
<td>M</td>
<td>mass palpation</td>
<td>lt SP</td>
<td>hypo</td>
<td>hyper</td>
<td>20</td>
<td>homo</td>
<td>early</td>
<td>strong</td>
<td>not performed</td>
<td>diffuse large B cell lymphoma</td>
</tr>
<tr>
<td>7</td>
<td>62</td>
<td>M</td>
<td>mass palpation</td>
<td>rt SP</td>
<td>hypo</td>
<td>hyper</td>
<td>20</td>
<td>hetero</td>
<td>early</td>
<td>strong</td>
<td>positive</td>
<td>pleomorphic adenoma</td>
</tr>
<tr>
<td>8</td>
<td>29</td>
<td>M</td>
<td>mass palpation</td>
<td>lt SP</td>
<td>iso and hyper</td>
<td>60</td>
<td>hetero</td>
<td>early</td>
<td>strong</td>
<td>not performed</td>
<td>macropidermoid carcinoma</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>8</td>
<td>F</td>
<td>mass palpation</td>
<td>rt SP</td>
<td>hyper</td>
<td>hypo</td>
<td>20</td>
<td>hetero</td>
<td>early</td>
<td>strong</td>
<td>not performed</td>
<td>mucoepidermoid carcinoma</td>
</tr>
</tbody>
</table>

F, female; M, male; SI, signal intensity; T1WI, T1-weighted images; T2WI, T2-weighted images; CE, contrast enhancement; DCS, dynamic contrast study

Malignant pleomorphic adenoma (Case 3) had

- coronal fast spin echo (FSE) T1-weighted images (T1WI) (500/20/1 [TR/TE/excitations]) and axial, coronal, sagittal images (T2WI) (4000/100/1 [TR/TE/excitations]; echo train length, 12). Parameters included an 18-cm field of view, sections 3- to 5-mm thick, and gaps of 1 mm. In 7 cases (Cases 2, 3, 4, 5, 6, 7 and 8), gadolinium diethylenetriaminepentaacetic acid (Gd-DTPA) (0.1 mmol per kg of body weight) was injected rapidly by hand as a bolus injection to obtain information regarding time versus increase in signal intensity of the tumor. In this dynamic contrast-enhanced study, pre-contrast fat-suppressed axial or coronal FSE T1WI was obtained first, and post-contrast images were obtained sequentially at intervals of 30 s. First post-contrast images were obtained 10 s after intravenous bolus injection of Gd-DTPA, and final images were obtained in 70 s. Post-contrast axial and coronal SE or fat-suppressed SE T1WI were obtained in 8 cases. Intravenous injection of Gd-DTPA was not performed in one young female patient (Case 9) because her parent rejected the procedure.

MRI findings were evaluated by 2 radiologists (F.U. and M.S.) who reached a consensus. Signal intensity was compared to skeletal muscle and classified as hypointense, isointense, or hyperintense. Maximum tumor diameter was measured using the most demonstrable slice direction image. The internal signal character of the tumor was classified as homogeneous or heterogeneous based on pre-contrast T1WI and T2WI. Time versus increase in signal intensity was classified as early when the lesion showed enhancement 10 s after injection, prolonged when the lesion showed no definite enhancement at 10 s and showed enhancement at 70 s, and absent when no contrast enhancement effect was seen on any sequential images. The final contrast effect was classified as strong when the lesion showed the same contrast enhancement effect as normal mucosa, moderate when the lesion showed definite enhancement but less than the normal mucosa, and absent when the lesion showed no signal increase. Margin conspicuity of the lesion was classified as clear or unclear. Lymphadenopathy was classified as positive when the minimum size of either side of the cervical lymph node was greater than 10 mm in diameter. A surgical pathologist (H.M.) evaluated resected specimens macroscopically and microscopically.

**Results**

First symptom, MRI findings, and pathological diagnoses are summarized in Table. The patient with malignant pleomorphic adenoma (Case 3) had...
Fig. 1. Benign pleomorphic adenoma of the soft palate 42-year-old woman (Case 2) presented with right soft palate mass. (a) Conventional spin echo T1-weighted image showing hypointense mass relative to skeletal muscle. (b) Fast spin echo T2-weighted image showing heterogeneous hyperintense mass.

a benign pleomorphic adenoma of the hard palate excised 19 years previously, and recurrent benign pleomorphic adenoma was surgically resected 3 years previously. Mass palpation was the first symptom and facial dysaesthesia was the second in Cases 5 and 6. Biopsy of the largest cervical lymph node revealed metastatic tissue in Case 4 (right superficial lateral cervical lymph node), Case 6 (left deep lateral cervical lymph node), and Case 9 (right deep lateral cervical lymph node).

One case of pleomorphic adenoma (Case 1) showed strong enhancement and another (Case 2) showed moderate enhancement on post-contrast T1WI. Both showed hypointensity on pre-contrast T1WI and hyperintensity on T2WI relative to skeletal muscle (Fig. 1). Recurrent malignant pleomorphic adenoma (Case 3) originating from the hard palate was located mainly in the nasal cavity. Soft palate squamous cell carcinoma (Case 4) showed moderate enhancement, and the central portion of the tumor showed little enhancement. Hard palate adenoid cystic carcinoma (Case 5) and diffuse large B cell lymphoma (Case 6) had unclear tumor margins (Figs. 2, 3). Although the palpable portions of these tumors were very small, the actual tumor sizes were over 50 mm, extending from the hard palate to the top of the maxilla. Both showed early enhancement on dynamic contrast study and strong enhancement on post-contrast T1WI (Figs. 2, 3). One of the mucoepidermoid carcinomas (Case 8) appeared as a hyperintense lesion on both T1WI and T2WI (Fig. 4). The right inferior part of this hyperintense portion had apparent wall thickening, and the signal was isointense on T1WI and slightly hyperintense on T2WI. This portion showed prolonged enhancement in dynamic contrast-enhanced study and moderate enhancement on post-contrast T1WI. Another case (Case 9) also showed a heterogeneous mass 20 mm in diameter containing a tiny very hyperintense portion on T2WI. Although contrast enhancement study was not performed in this case, signal intensity surrounding the central hyperintense portion of this tumor was similar to that of pleomorphic adenomas. Cervical lymph nodes also showed the same signal intensity as the primary mass in both T1WI and T2WI.

Tumors were excised surgically in Cases 1, 2, 3, 7, 8, and 9. Systemic chemotherapy was also performed in Case 9. Squamous cell carcinoma (Case 4) and diffuse large B cell lymphoma (Case 6) were treated with systemic chemotherapy and radiation therapy. Adenoid cystic carcinoma (Case 5) was treated with transarterial superselective injection chemotherapy. Macroscopic findings of surgically resected tumors and surrounding tissue showed unclear margins in Cases 1, 2, 7, 8, and 9. Perineural spread was not disclosed pathologically in all cases. In Case 3, the lesion originating from the hard palate was located within the nasal cavity. Macroscopic findings of the above hyperintense mucoepidermoid carcinoma (Case 8) revealed that this tumor contained hemorrhagic fluid. A fibrous capsule was also found. Intermediate-grade mucoepidermoid carcinoma proliferated into the cystic cavity and invaded the fibrous capsule. On microscopy, the other case (Case 9) showed low-grade mucoepidermoid carcinoma. The precise correlation between macroscopic and microscopic examination with regard to the above tiny very hyper-
intense portion on T2WI was not obtained.

No definite recurrence was found in the postsurgical interval: 7 years in Case 1; 6 years in Cases 2, 3, and 8; and 3 years in Case 7. Deterioration of systemic lymphadenopathy resulted in death in Case 4. The contrast enhancement effect in Case 5 decreased in both the dynamic contrast study and post-contrast images after superselective arterial
Fig. 4. Mucoepidermoid carcinoma of the hard palate 29-year-old man (Case 8) presented with a right hard palate mass. (a) Conventional spin echo T₁-weighted image showing hyperintense mass (arrow). Right inferior part of this hyperintense mass shows isointensity (white arrow). (b) Fast spin echo T₂-weighted image showing hyperintense mass (arrow). The right inferior part of this hyperintense mass also shows slight hyperintensity (white arrow). (c) Dynamic contrast enhancement study showing the right inferior part of this tumor indicating prolonged enhancement (white arrow). (d) Post-contrast T₁-weighted image showing moderate contrast enhancement (white arrow). Central hyperintense portion shows no definite contrast enhancement effect.

Discussion

MRI findings demonstrate well the infiltration of malignant palatal tumor into surrounding bony structures. The normal palate is composed anatomically of soft and hard parts. The anterior medial part of the hard palate originates from the embryological primary palate, and the remaining posterior parts of the hard palate and all of the soft palate originate from the embryological secondary palate that develops laterally and grows medially. Minor salivary glands are distributed throughout the oral cavity, with the highest concentrations in the lips and palate. Tumors can occur in any of the minor salivary glands, although 50% form on the palate, with the hard palate being the most common site. Malignant tumors tend to occur more frequently in the minor salivary glands than the major salivary glands. Palatal salivary gland tumors have been reported to have malignancy rates of 42% to 82%. Tumors of the minor salivary glands are the second most common type of soft palate tumor. Tumors can occur in any of these glands, the dominant site being the junction of the hard and soft palate. Pleomorphic adenoma is the most prevalent type of adenoma in the palate. Although benign, it is poorly encapsulated and has a tendency to recur locally after inadequate resection. In addition, even benign pleomorphic adenomas

Chemotherapy in one year after first clinical onset. Resolution of facial dysaesthesia and reduction of palpable mass were achieved. The case of diffuse large B cell lymphoma (Case 6) showed complete remission at one year after systemic chemotherapy. Low-grade mucoepidermoid carcinoma with metastasis to bilateral cervical lymph nodes (Case 9) showed gradual enlargement of cervical lymphadenopathy one year after systemic chemotherapy.
can recur in malignant histology when excision is incomplete. The reported interval to recurrence of pleomorphic adenoma is relatively long, as in our case of malignant pleomorphic adenoma. Imaging findings of both benign and malignant pleomorphic adenoma showed heterogeneous features. In addition, on contrast enhancement study, even benign pleomorphic adenoma showed strong enhancement.

It is difficult to detect tumors of the hard palate by physical examination alone, so hard palate tumors have often invaded deeply into the maxillary bone or sphenoid bone by the time they are discovered. As bony structures of the hard palate show signal voids in MR images, it is useful to estimate the tumor origin if the normal hard palate signal void is visible. It is necessary to know the extent of bony destruction and tumor infiltration in the hard palate when determining the therapeutic strategy. Evaluation by thin-slice high-resolution computed tomography (CT) is preferable. In our cases, we performed thin-slice high-resolution helical CT in diffuse large B cell lymphoma, which demonstrated bony destruction well.

Perineural spread along the palatine branches of the maxillary nerve is also one of the most refractory phenomena associated with palatal malignancies. Spread can occur intracranially via cranial nerves. Our Cases 5 and 6 showed direct maxillary bone involvement, but pathologically definite cranial nerve involvement was not disclosed. Clinically, both showed dysaesthesia, so perineural spread along infraorbital nerve involvement could be suspected. Malignant lymphoma is known to occur at any site in the human body. In addition, these lesions show a variety of imaging findings. In the present study, both peripheral T cell lymphoma and diffuse large B cell lymphoma showed hypointensity on T1WI and hyperintensity on T2WI, which were thought to be nonspecific signal characteristics. The contrast enhancement effects of these tumors showed the same characteristics. With regard to the dynamic contrast study, we performed FSE MR sequences to obtain information regarding the extent of tumor neovascular formation and to evaluate the therapeutic effect of chemotherapy. The early enhancement portion of the adenoid cystic carcinoma decreased in size on dynamic contrast enhancement study, indicating therapeutic effects. We performed this dynamic contrast study using FSE rather than gradient echo to avoid the susceptibility effect because the palate is surrounded by air. Image direction is one of the important factors of this dynamic contrast study, and coronal image was superior to axial image to show craniocaudal direction maxillary bone invasion.

Mucoepidermoid carcinoma is classified as low, intermediate, or high grade based on histological findings. In Case 8, the palatal tumor was revealed as a cystic mass. Although this case was classified as intermediate grade, cystic mucoepidermoid carcinomas are often low grade and rarely infiltrate surrounding tissue. Nevertheless, attention should be paid to the tumor’s intracavitary extension and invasion of the cyst wall. In addition, even if the palpable portion of the tumor is small, this less symptomatic lesion would infiltrate surrounding structures in cases of intermediate- or high-grade mucoepidermoid carcinoma. Although excision requires a safety margin, repair of the palate for patient’s oral function is one of the most important considerations.

The embryologic origins of the soft palate and majority of the hard palate are the same, but the majority of soft palate malignancies are squamous cell carcinomas. Squamous cell carcinoma can also invade from the oral cavity or pharyngeal region to the palate. Imaging findings of palatal squamous cell carcinoma are identical to those of other head and neck squamous cell carcinomas and often show central necrosis on pathological examination. Peripheral thick, irregular contrast enhancement was observed with a central poorly enhanced portion. MRI findings of palatal squamous cell carcinoma were slightly different from those of other benign and malignant palatal neoplasms and showed imaging features common to other head and neck squamous cell carcinomas. Although the tumors were expansive, the borders between the tumors and surrounding tissue are unclear in many cases. Minor salivary gland tumors are the second most common neoplasms of the soft palate. Thus, both squamous cell carcinoma and tumors of minor salivary gland origin as well as malignant lymphoma should be included in the differential diagnosis of tumors of the soft palate.

In conclusion, even when the palpable portion is small and MR imaging findings show clear margins, a palatal tumor could infiltrate surrounding structures. We would refrain from surgery when MRI demonstrates deep infiltration of palatal tumor into maxillary bone. MR imaging has limitations in elucidating the precise histology of palatal tumors, but it can contribute to selection of the optimal therapeutic strategy.

References

1. Smoker WRK. The oral cavity. In: Som PM,


