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Endolymphatic Sac Tumor, A Patient Report

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Endolymphatic sac tumors are rare low malignant neoplasms of the petrous temporal bone, with symptoms referable to auditory, vestibular or facial nerves, which should be strictly discriminated from benign tumors of the temporal bone. Differential diagnosis between both at the early stages of checkup controls the treatment and prognosis. Complete surgical resection is the treatment of choice, which commonly provides long-term control. We have experienced a 48-year-old man with progressive hearing loss, unsteadiness and constant tinnitus. Computed tomography and magnetic resonance imaging (MRI) demonstrated a tumor invading the posterior petrous bone, extending to the posterior fossa. In the course of image diagnosis of his disease, we observed diagnostic efficacy of 3-tesla MRI, which showed excellent lesion visualization even in a small-size endolymphatic sac tumor. The intraoperative pathologic diagnosis was not available.

Key words: endolymphatic sac tumor; pathologic diagnosis; temporal bone surgery; 3-tesla magnetic resonance imaging

Endolymphatic sac tumors, rare lesions of the petrous temporal bone, arise in the vicinity of the inner ear but may extend to both the posterior fossa and the middle ear. In 1984, Hassard et al. proposed that the endolymphatic sac could give rise to adenomatous papillary tumors (Hassard et al., 1984). Five years later, Heffner (1989) reviewed 20 papillary-cystic temporal bone tumors, reporting the origin as the endolymphatic sac. Despite a benign histopathologic appearance, these lesions are regarded clinically adenocarcinomas since then often are locally invasive. Endolymphatic sac tumors frequently manifest sensorineural hearing loss, facial paralysis and disequilibrium. Upon imaging, they show significant dural involvement. Light microscopic patterns may be follicular or papillary and solid. Both patterns often are mixed in the same tumor. Magnetic resonance imaging (MRI) variegated lesion of the temporal bone; multiple foci of high signal intensity indicate the hypervascular part of the tumor, scattered low-signal foci represent connective tissue scarring following bleeding. We present a patient with endolymphatic sac tumor, describing clinical, imaging, intraoperative and pathologic features.

Abbreviations: CT, commputed tomography; MRI, magnetic resonance imaging; 3T, 3-tesla

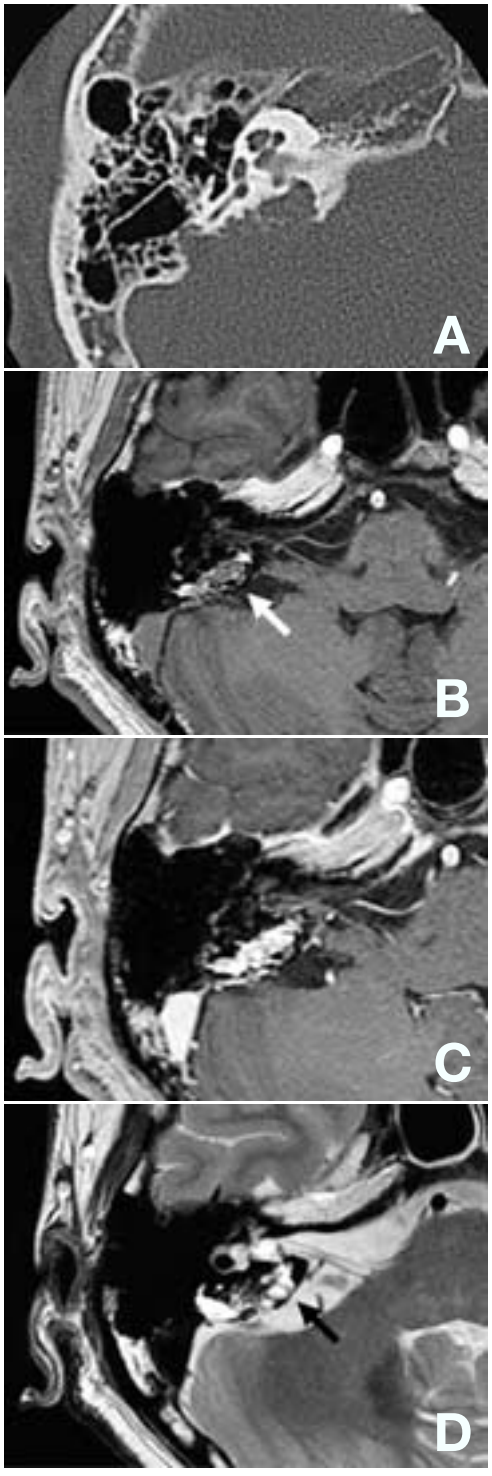

Fig. 1. Radiological findings in the present patient.
A: Computed tomography (CT) scan of the temporal bone;
B: T1-weighted 3-tesla (3T) magnetic resonance imaging (MRI);
C: T1-weighted 3T MRI after gadolinium administration;
D: T2-weighted 3T MRI.
The tumor arises along the right petrous ridge, producing bone erosion near the inner ear. Heterogenous signal intensity is seen by T1- and T2-weighted MRI (arrow).

Patient Report

A 48-year-old man was admitted to Tottori University Hospital in 2005 because of right-sided sensorineural hearing loss accompanied by persistent tinnitus. He also had recurrent episodes of disequilibrium and mild headache. Otologic examination was performed, including pure-tone audiometry, impedance testing and vestibular testing. Audiometric data indicated complete hearing loss in the right-ear, with normal impedance. Caloric testing demonstrated no response to irrigation of the right external auditory canal. Otoscopic observations, facial nerve examination and findings concerning remaining cranial nerves were normal. Systemic examination for von Hippel-Lindau disease was performed including brain and dorsal MRIs, whole body computed tomography (CT), ophthalmologic and also genetic examination (the deficit of 3p25-26) revealing all negative results. CT of the temporal bone showed an osteolytic mass on the posteroinferior side of the petrous bone. The mass extended to the dura of the posterior fossa and invaded the right inner ear. On 3T MRI with gadolinium enhancement, the tumor showed heterogeneous signal intensity. Scattered low intensity areas appeared among multiple high-intensity foci in both T1- and T2-weighted images (Figs. 1 and 2). Angiography demonstrated a hypervascular lesion in the petrous bone supplied by the occipital and ascending pharyngeal arteries. Prior to surgery, these arteries were embolised (Fig. 3). The patient underwent mastoidectomy, disclosing a hard mass between the posterior fossa and the lateral hemicanal. The mass extended to the jugular bulb, internal auditory canal, retrofacial space and infralabyrinthine air cells. After exposing the sigmoid sinus by

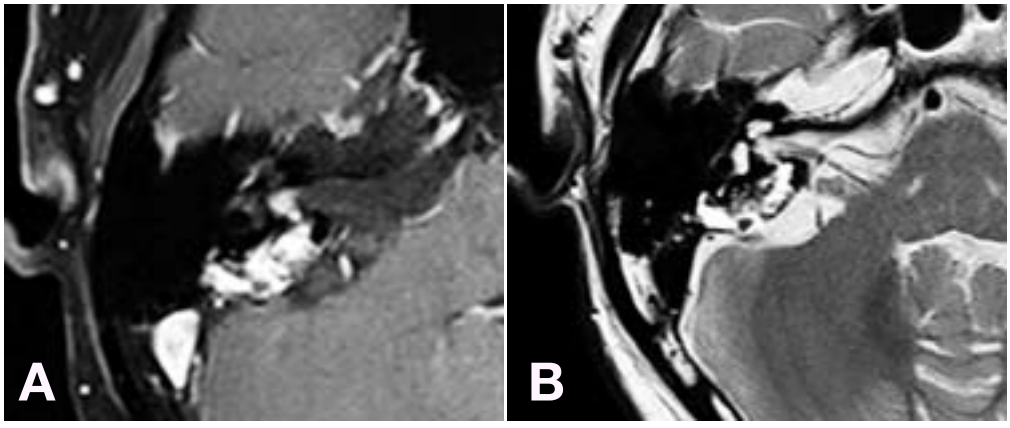

Fig. 2. Typical images in the present patient using 1.5-tesla MRI (**A**: T1-weighted; **B**: T2-weighted). Tumor visualization is inferior to that with 3-tesla MRI.

making a Bill's island bone flap, the tumor was found to extend to the posterior fossa dura and also the middle fossa dura. We then obtained tissue for intraoperative pathologic examination. The first 2 small specimens from the surface of the mass were not diagnostic of tumor, showing granulomatous reaction with fibrosis, hypervascularity and cholesterol deposition. As preoperative imaging showed a tumor, we submitted another specimen from a deeper, reddish portion of the mass, obtaining an intraoperative pathologic diagnosis of endolymphatic sac tumor. The 3rd tumor was resected in a piece meal fashion, resulting in incomplete removal with a portion of the tumor tissue attached to the jugular bulb.

Postoperative pathologic examination of the resected tissue demonstrated cuboidal to high columnar atypical cells with round nuclei, a papillary arrangement (Fig. 4) and an invasion of the bony structures. Immunochemical study showed the tumor cells to be reactive for cytokeratin AE1/3, vimentin, epithelial membrane antigen and neuron-specific enolace, focally reactive for glial fibrillary acidic protein. Tumor cells were negative for carcinoembryonic antigen, chromogranin, synaptophysin, cluster designation 34, cluster designation 117, carbohydrate antigen 19-9, S-100 protein, anti lymphatic endothelium marker D2-40 and Ki-67 (expression < 1%).

On the 1st postoperative day, the patient had slight cerebrospinal fluid leakage from the thinned

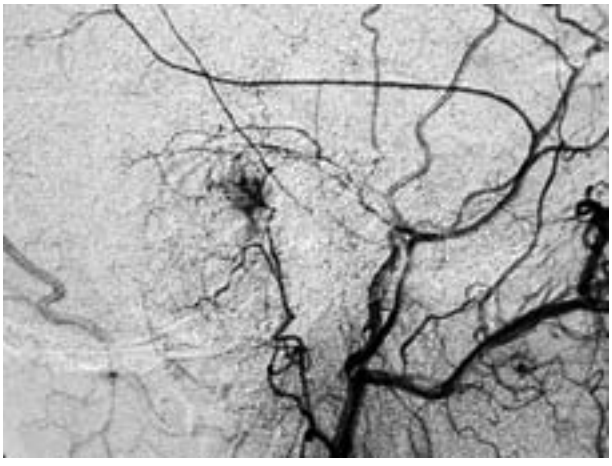

Fig. 3. Right external carotid arteriogram demonstrates blood supply from the postauricular artery.

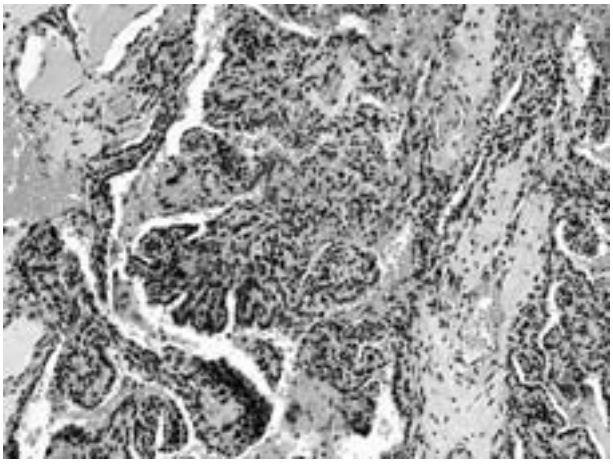

Fig. 4. Low-power photomicrograph of the resection specimen demonstrates a papillary growth pattern characteristic of endolymphatic sac tumor (hematoxylin and eosin, × 100).

area of the posterior fossa dura. This complication was repaired under general anesthesia. No other complications occurred. Stereotactic radiotherapy with 65 Gy was administered after the repair surgery. The patient has undergone regular follow-up for 30 months. CT and MRI have detected no residual tumor enlargement.

Discussion

Endolymphatic sac tumors are rare tumors of the temporal bone, recently have been recognized as a distinct entity after previously having been classified with other papillary middle ear tumors (Gaffey et al., 1988, 1994; Li et al., 1993). In 1989, Heffner reviewed 20 papillary tumors of the temporal bone, concluding that all were low-grade adenocarcinomas likely to have originated from the endolymphatic sac (Heffner, 1989). Only 1 case had been reported prior to that, by Hassard et al. (1984), who definitively identified the tumor's origin as the endolymphatic sac upon unexpectedly finding a mass during sac decompression surgery.

Chief clinical manifestations of endolymphatic sac tumors include sensorineural hearing loss, disequilibrium, facial nerve paralysis and palsies involving other nearby cranial nerves. Although complications of endolymphatic sac tumor vary with extent of tumor growth, the most consistent early symptom is sensorineural hearing loss. Endolymphatic sac tumor is difficult to differentiate from other lesions of the temporal bone and posterior fossa, typically being discovered at an advanced stage and lacking specific symptoms. In our patient an otologic examination indicated only a temporal bone lesion of unknown nature. CT, MRI and angiography were needed to determine that a tumor was present and determine some of its characteristics. CT imaging displayed a destructive lesion of the temporal bone involving the posterior aspect of the petrous pyramid, which lies mainly within the posterior part of the petrous bone. MRI at 3T with gadolinium enhancement disclosed a heterogeneous lesion, while scattered low-intensity areas were admixed with multiple high-intensity foci on both T1- and T2-weighted images. A portion of the dura showed gadolinium enhancement indicating tumor invasion. Angiography depicted a hypervascular lesion in the petrous pyramid, supplied predominantly by a branch of the occipital artery. The differential diagnosis included paraganglioma, endolymphatic sac tumor, metastasis from an occult primary cancers, chondrosarcoma and cholesterol granuloma. Paraganglioma and endolymphatic sac tumor were most likely based on tumor location, bone destruction, signal intensity patterns on MRI and the feeding artery. Endolymphatic sac tumor is a locally aggressive malignant tumor and paraganglioma is a benign neoplasm, preoperative differentiation between the 2 diagnoses was important for planning surgical approach for resection. Unfortunately, endolymphatic sac tumor could be diagnosed only intraoperatively. Ricards and Clifton (2003) reported that endolymphatic sac tumor was heterogeneous in signal intensity pattern, with heterogeneous gadolinium enhancement. Multiple high-intensity foci on both T1 and T2-weighted images indicated the presence of methemaglobin, blood-filled or proteinaceous cysts and cholesterol clefts. Mukherji et al. (1997) performed MRI in 15 cases of endolymphatic sac tumor, noting that appearance varied with tumor size. Lesions 2 cm or less in diameter was heterogeneous, with a rim of increased signal on T1-weighted images. Tumors were enhanced with gadolinium administration. Larger tumors showed intratumoral areas of increased signal on non-gadolinium T1-weighted images. Patel et al. (2006) reviewed 31 cases of endolymphatic sac tumor and described T1-weighted MRI post-gadolinium scans showed heterogeneous enhancement in all cases (100%). T2-weighted images showed heterogeneous signals in all lesions (100%). Those authors proposed that signal characteristics could be used to differentiate endolymphatic sac tumor from other lesions occurring in this region (Mukherji et al., 1997). Our patient's tumor was 2 cm in diameter, making it comparable to the smaller tumors above. How-

ever, 3T MRI showed a heterogeneous pattern without a rim of increased signal in T1-weighted images without gadolinium. Typical images comparing 3T MRI (Fig. 1) with 1.5-tesla MRI (Fig. 2) demonstrate a favorable higher signal-to-noise ratio using 3T MRI. This modality may provide improved imaging for use with intraoperative navigation systems.

Pathologically, endolymphatic sac tumors appeared nonaggressive, but these tumors often are locally invasive (Luff et al., 2002). Heffner (1989) reported endolymphatic sac tumor morphology as including complex arrays of interdigitating papillary processes infiltrating surrounding tissue, embedded in dense fibrous tissue showing evidence of past hemorrhage as well as cholesterol clefts and inflammatory cells. The latter tumor characteristics posed difficulties in intraoperative pathologic assessment, which were surmounted only by resecting the superficial part of the tumor and then submitting a specimen from the deep, hypervascular part of the lesion. Immunopathological findings of our patient were positive expression of cytokeratin AE1/3, vimentin, glial fibrillary acidic protein and negative of carcinoembryonic antigen, synaptophysin, carbohydrate antigen 19-9 and anti lymphatic endothelium marker D2-40. These results corresponded to the reports of Asano et al. (1999) and Rodrigues et al. (2004). Their reports showed the activity of the endolymphatic sac tumors related to the level of Ki-67 and the characteristics of tumors were expression of glial fibrillary acidic protein and vimentin. Fortunately, the level of Ki-67 was below 1% in our patient, deliberate long-term observation was necessary for the patient.

Ultimately, tumor removal was incomplete because dense connective tissue remaining in the operative field interfered with and precluded enbroc resection. Devaney et al. (2003) reported that most patients with endolymphatic sac tumor were difficult to cure by surgical resection. Treatment options include embolisation followed by subtotal resection, as well as other strategies; nonetheless, surgical excision remains the mainstay of therapy for endolymphatic sac tumor. Efficacy of stereotactic radiotherapy is not known, but our patient underwent this treatment in view of subtotal resection (Heffner, 1989; Megerian et al., 1995; Hansen and Luxford, 2004). Two previous reports described remote metastasis of endolymphatic sac tumor; Ferreira et al. (2002) and Robson et al. (1990). In 2005, Bambakidis et al. reported the 1st case of metastasis to the spine (Bambakids, 2005). Given the uncertainties, our patient will need careful follow-up connecting both local recurrence and metastasis.

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