

Cerebellopontine angle meningioma presenting with hearing loss

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A 48-year-old woman with a cerebellopontine angle meningioma presented with sensorineural hearing loss. The lesion was nearly 4 cm in maximum dimension and extended into the internal auditory canal. Hearing loss resulting from cerebellopontine angle tumor is most commonly caused by vestibular schwannomas, which arise directly from the sheath of the vestibular nerve (VIII) in the internal auditory canal. Our case provides a review of magnetic resonance imaging features that aid in differentiation of enhancing cerebellopontine angle masses that can have similar clinical presentations.

Introduction

Mass lesions in the cerebellopontine angle (CPA) can be difficult to differentiate based solely on clinical symptoms and physical examination. Both benign and malignant entities, if encroaching on the same cranial nerve, can present in an identical manner. The symptom of unilateral sensorineural hearing loss is most commonly associated with vestibular schwannomas (VS), since these arise directly from the sheath of the vestibular nerve in the internal auditory canal (IAC). However, meningiomas that extend into the IAC or the rare intracanalicular meningiomas may present in a similar manner to vestibular schwannomas, as in our patient. Differentiation of these lesions is important because it alters pre-operative management, such as the need for presurgical embolization of meningiomas.

Magnetic resonance imaging (MRI) is a vital tool in differentiating different types of CPA masses. Knowledge of typical signal characteristics, more specific imaging features such as a hemispheric or ice-cream-cone shape, presence or absence of calcification, adjacent hyperostosis, a dural tail,

extension into one or more skull base foramina, enlargement of the IAC, and advanced MRI data such as MR perfusion ratios and MR spectroscopy metabolite peaks can help provide a more specific diagnosis. Our case highlights the importance of conventional anatomic MRI and CT in the diagnosis of a case of a CPA meningioma that clinically mimicked a vestibular schwannoma.

Case report

A 48-year-old woman with no prior medical history presented with one year of increasing difficulty hearing music in her left ear while running marathons with her headset on. The patient also reported slight difficulty swallowing. Physical examination was normal except for mild decreased sensation to touch in the left V3 distribution. The patient underwent an audiogram, which showed minimal sensorineural hearing loss in the left ear.

An MRI was obtained for further evaluation and showed a 39 x 22 x 37-mm extra-axial mass along the left petrous ridge in the CPA. The lesion was isointense signal on T1 and intermediate-high signal on T2 (Fig. 1). There was homogeneous enhancement with a small dural tail and extension into the left internal auditory canal (Fig. 2), as well as extension into Meckel's cave anteriorly and the jugular foramen inferiorly (Fig. 3). Diffusion-weighted imaging showed mildly elevated DWI signal with relatively low ADC values near those of adjacent parenchyma (Fig. 4). The mass had a broad, flat base along the petrous ridge with a hemispheric shape that involved Meckel's cave anteriorly, extended through the porus acousticus into the IAC laterally, and involved the jugular foramen inferiorly. Mass effect on the pons, middle cerebellar peduncle, fourth ven-

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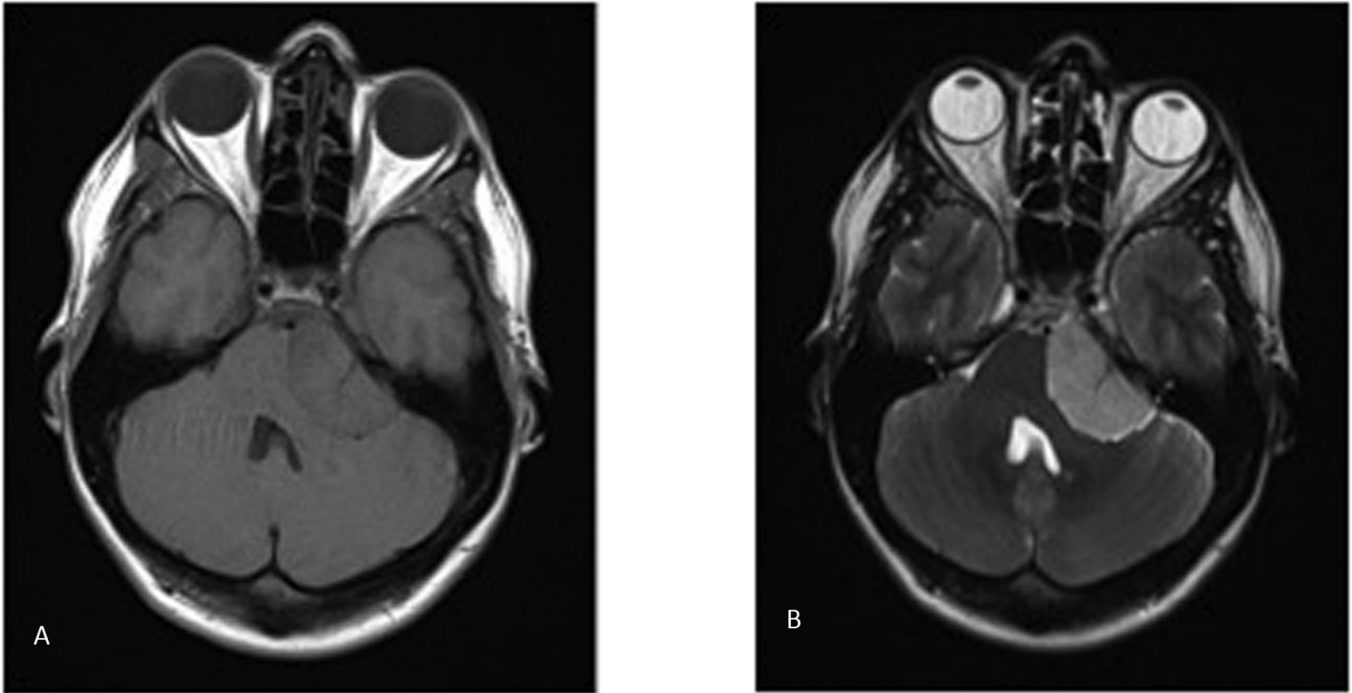


Figure 1. 49-year-old woman with meningioma. A. Axial T1-weighted MRI image demonstrates a mass isointense to cerebral cortex involving the left cerebellopontine angle. B. Axial T2-weighted MRI image at the same level shows the mass is intermediate high-signal-intensity (higher than cerebral cortex but less than CSF). There is mass effect on the 4th ventricle and the pons without edema.

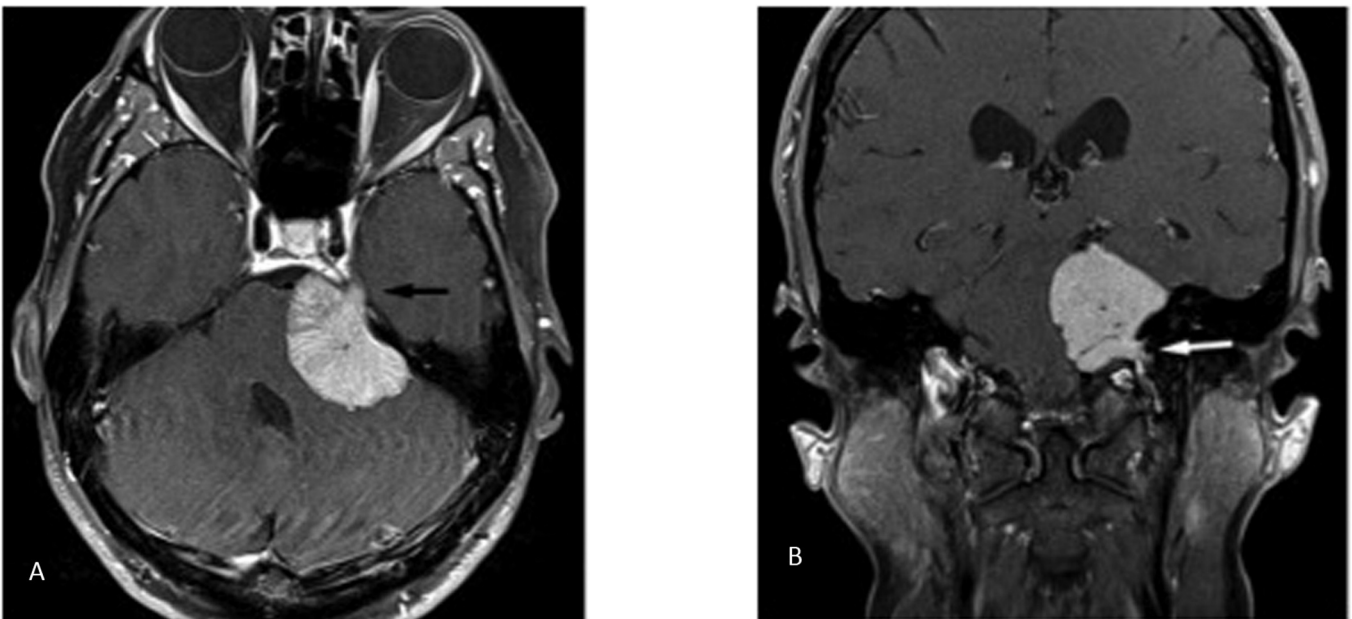


Figure 2. 49-year-old woman with meningioma. Axial (A) and coronal (B) T1-weighted fat-suppressed postgadolinium MRI images show avid, homogeneous enhancement of the mass. There is a small dural tail (black arrow) and extension into the left IAC via the porus acusticus (white arrow). The IAC is not dilated. Mass effect is again seen on the pons, middle cerebellar peduncle, and 4th ventricle.

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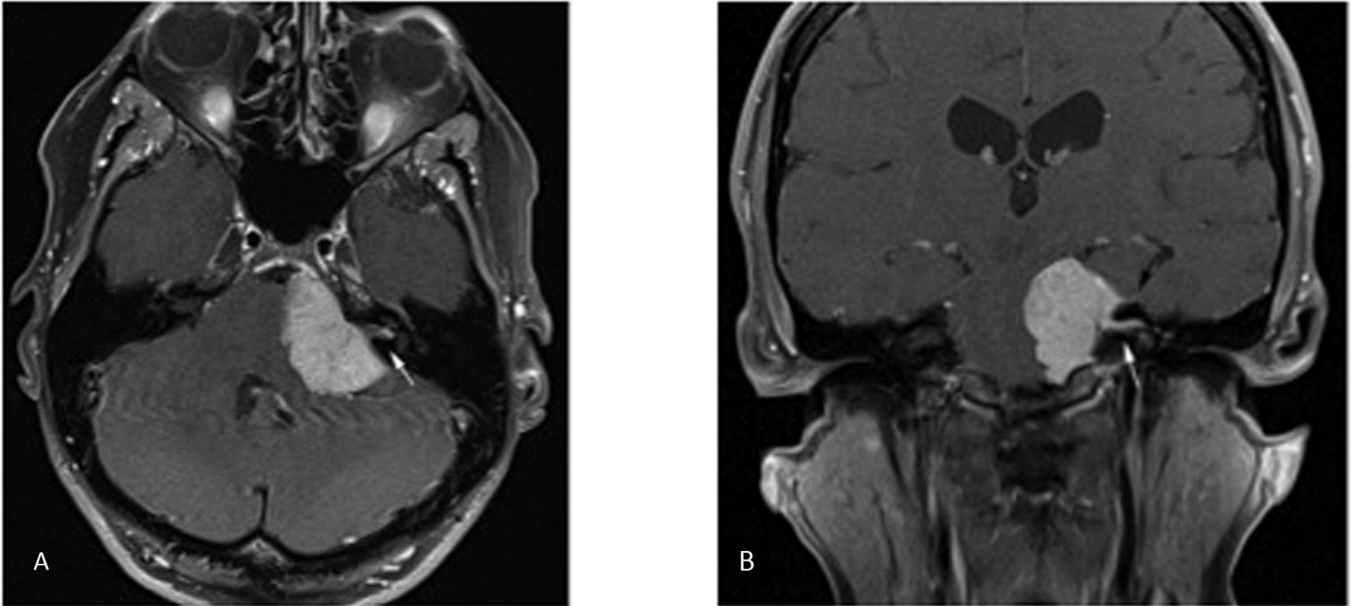


Figure 3. 49-year-old woman with meningioma. Axial (A) and coronal (B) T1-weighted fat-suppressed postgadolinium MRI images show extension of the mass into Meckel's cave anteriorly (white arrow) and extension into the jugular foramen inferiorly (white arrow).

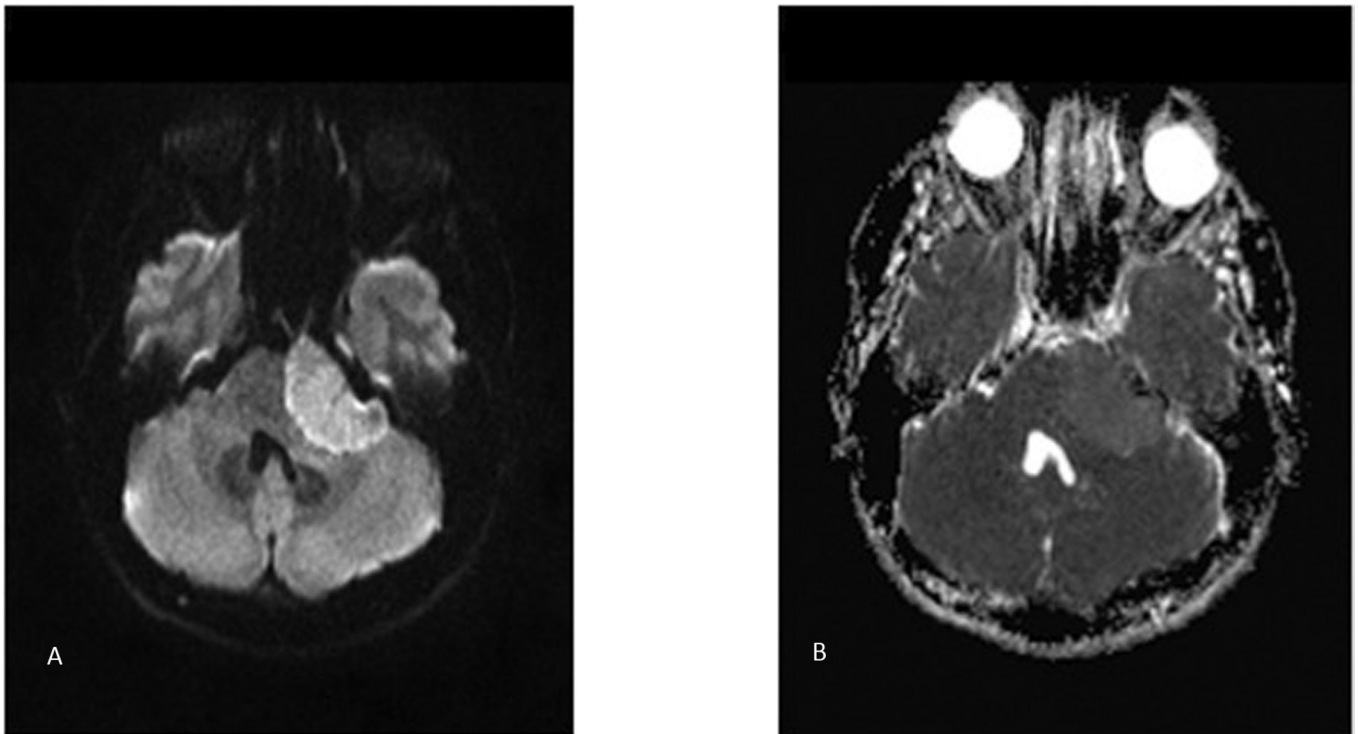


Figure 4. 49-year-old woman with meningioma. A. Axial DWI shows hyperintensity of the mass in the left CPA. B. Axial ADC image at the same level shows relatively low ADC values near those of adjacent parenchyma. Mass effect on the midbrain and 4th ventricle is seen again.

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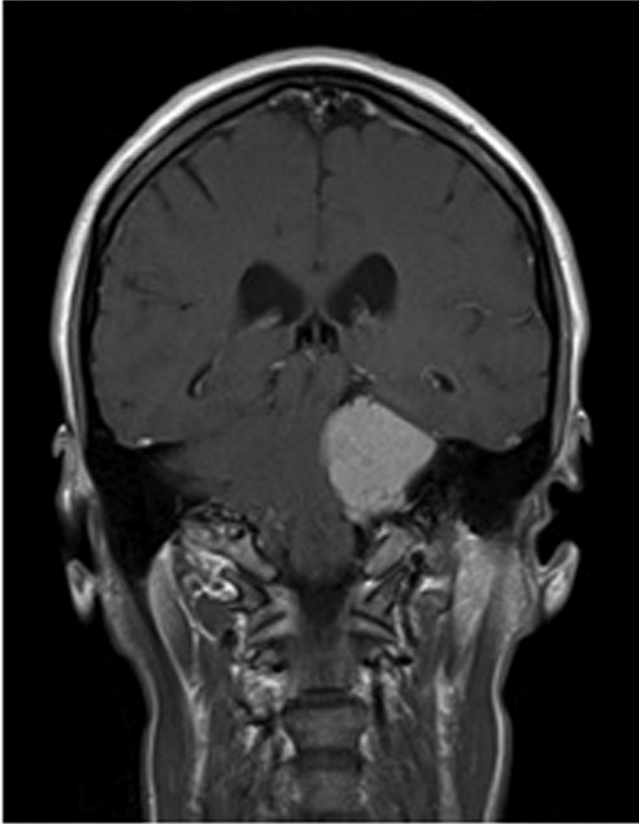


Figure 5: 49-year-old woman with meningioma. Coronal T1-weighted postgadolinium MRI shows enhancement of the left CPA mass. Mass effect is seen on the pons, with inferior herniation of the cerebellar tonsils into the foramen magnum.

tricle, and left cerebellum was present, with effacement of the left ambient cistern. There was downward tonsillar herniation through the foramen magnum (Fig. 5). There was no peritumoral edema. CT obtained for surgical planning showed mild hyperostosis of the adjacent petrous ridge, with dense calcification of the anterior portion of the mass (Fig. 6).

On the day prior to surgery, the tumor was embolized via the left meningeal apophyseal artery. At surgery, a transpetrosal approach was used with temporal craniotomy. Under intraoperative cranial nerve monitoring, gross total microsurgical resection of the tumor was accomplished, followed by reconstruction. The tumor was found to extend into Meckel's cave, the internal auditory canal, and the jugular foramen. Postsurgical recovery was uneventful. The final pathological diagnosis was meningioma, without atypical features (WHO grade I).

Discussion

According to the schema of Bonneville et al. (1-2), tumors of the cerebellopontine angle (CPA) may be categorized by key features on contrast-enhanced MRI, which then limit the differential diagnosis. Nonenhancing lesions

are further divided into those that have high or low signal on T1-weighted MRI. Enhancing lesions, such as in the case presented here, are divided by anatomic compartment: intra-axial, extra-axial, and skull base. Enhancing extra-axial lesions account for 80% to 95% of CPA masses. The differential diagnosis for enhancing extra-axial lesions includes lesions of the nerves, lesions of the arteries, and lesions of the meninges.

Nerve lesions that may occur in the CPA include schwannomas of the various nerves in the region; they may often be distinguished by their anatomic location (1-3). VS is typically an ice-cream-cone-shaped mass along the vestibular nerve (VIII) spilling out of the internal auditory canal. Typically, the mass erodes the walls of the porus acusticus, causing dilatation of the IAC (4). It is usually isointense on T1, hyperintense on T2, and shows homogeneous avid enhancement. VS is the most common CPA region tumor, accounting for approximately 70-80% of lesions (5). Trigeminal (V) schwannomas typically involve Meckel's cave, while facial nerve (VII) schwannomas typically involve the geniculate fossa, and mixed nerve (IX, X, XI) schwannomas typically involve the jugular foramen. Due to the limited space in the CPA region, it may be difficult to determine the anatomic origin of large lesions on imaging.

The enhancing arterial lesion that may occur in the CPA is a vertebrobasilar aneurysm (6). The typical aneurysm is well defined and round in shape. Because of flow void, they are typically hypointense on T2-weighted images, unless there are areas of thrombosis and hemorrhage, resulting in more complex T2 signal.

Meningeal lesions that may occur in the CPA region include metastasis, melanoma, sarcoidosis, tuberculosis, and meningiomas (1-3). Metastases are typically multiple, and sometimes there is a known primary malignancy. Melanoma metastases may be distinguishable from other metastases if they show high signal on T1-weighted images due to high melanin content (7). However, this is an uncommon finding. Neurosarcoidosis typically involves the meninges at multiple sites, with lesions that are hypointense to mixed signal on T2-weighted images and that enhance (8). Meningeal tuberculomas may demonstrate nodular or ring enhancement with central hypointensity on T2-weighted images due to caseation (9). There may be multifocal meningeal involvement.

Meningiomas are the second most frequent CPA mass, accounting for 10% to 15% of cases (10). On CT, approximately 20% will show calcification, and some may exhibit adjacent bone hyperostosis or enostotic spurs (11). On MRI, they may have a distinctive shape, typically a broad base at the meningeal origin and a hemispheric shape on the opposite side. Most are isointense to cortex on T1 and T2, with homogeneous avid enhancement, similar to schwannomas. In 60% to 70% of cases, there may also be enhancement of nonneoplastic thickened peritumoral dura, termed the "dural tail sign." Although the dural tail is most common in and highly suggestive of a meningioma, it has been reported in less common CPA lesions and adjacent to a VS (12).

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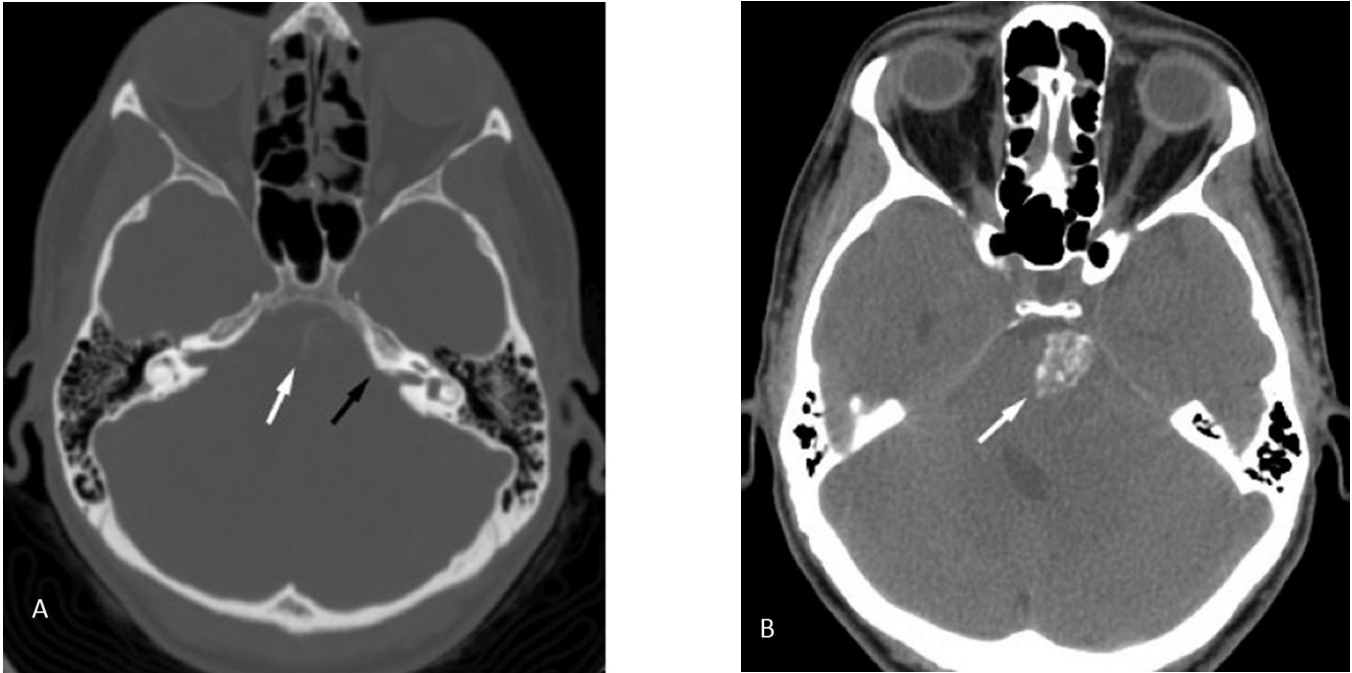


Figure 6: 49-year-old woman with meningioma. Axial CT in (A) bone window and (B) soft-tissue window shows subtle hyperostosis of the left petrous ridge at the porus acusticus (black arrow) and coarse calcification (white arrows) anteriorly within the mass.

CPA meningiomas may be difficult to differentiate from VS on the basis of imaging. While the majority of VS arise from the sheath of the inferior vestibular nerve in the IAC, meningiomas arise from arachnoid meningotheial cells. Except for the rare intracanalicular meningioma, the CPA meningioma origin is external to the IAC. Additionally, when a meningioma does grow into the IAC, it does not tend to enlarge the porus acusticus, a feature different from vestibular schwannoma (1, 4).

In a prospective study of 20 patients with CPA tumors (15 with VS and five with meningiomas), Thamburaj et al. found that 94% of the VS demonstrated microhemorrhages on T2*-weighted gradient-echo (GRE) MRI compared with none of the meningiomas (13). They concluded that in the clinical scenario of differentiation between VS and CPA meningioma, the T2*-weighted GRE showed a sensitivity of 93.8%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 83.3%. However, this sequence is not typically included in a standard enhanced brain MRI, and for T2 TSE and FLAIR, pulse sequences found in more standard brain MRI, the sensitivity for microhemorrhage was only 12.5% (13). Diffusion-weighted imaging, a sequence commonly performed with standard brain MRI, has not been proven to aid in differentiation between CPA meningioma and VS.

Complicating the issue of distinguishing enhancing extra-axial CPA region tumors from one another is the possibility that these lesions may occur concurrently. Various case reports describe the simultaneous occurrence of VS and meningioma in the same CPA region (14-15). As seen

in our patient, any lesion involving the IAC may result in sensorineural hearing loss by either directly injuring the nerve or interrupting cochlear blood. Thus, clinical symptoms may not assist when imaging differentiation is difficult.

Two advanced MRI tools are available to help in these complicated cases. Dynamic contrast-enhanced perfusion MRI can potentially differentiate VS and CPA meningiomas. Meningiomas are reported to have very high mean regional cerebral blood volume ratios that are statistically different than schwannomas (16). Perfusion imaging has also been shown to differentiate between other types of enhancing CPA masses, including lymphoma or abscess vs. metastasis and hemangioblastoma vs. lymphoma. Proton MR spectroscopy is another advanced MRI option. Specific signs of CPA meningiomas include a combination of elevated glutamate/glutamine and a characteristic presence of alanine at 1.5 ppm (17). A myo-inositol peak in schwannomas at 3.55 ppm has also been demonstrated (1).

Ultimately, our patient presented with symptoms most likely resulting from a VS. However, salient anatomic MRI and CT features of a CPA meningioma were present to allow correct diagnosis. Pre-operative diagnosis is important for presurgical embolization used for meningiomas. In more complex cases, perfusion imaging and MR spectroscopy may potentially allow differentiation of enhancing extra-axial CPA masses and help guide therapeutic management.

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