Radiologic Pearls of Vestibular Schwannomas

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Outline

• Our Patient Clinical Presentation
• Our Patient Radiologic Findings
• Cerebellopontine Angle Anatomy
• Differential Diagnosis Based on Imaging Findings
• General Considerations on Vestibular Schwannomas
• Clinical Findings in Vestibular Schwannomas
• Menu of Tests for Vestibular Schwannomas
• Radiographic Features of Vestibular Schwannomas
• Differential Diagnosis Revisited
Our Patient: Clinical Presentation

- **HPI:** Mr. P is 63-year-old male with recent onset left-sided hearing loss and slight occasional imbalance. Denies vertigo.

- **Physical Examination:** Neurological exam was unremarkable. Facial sensation, strength were intact bilaterally. No gait abnormalities.

- **Audiometry:**
  - Audiogram showed mild-moderate left-sided sensorineural hearing loss of high frequencies.
  - Brainstem auditory evoked potential showed no response on the left.
Now we will look at the ACR appropriateness criteria for the imaging diagnostic evaluation of a patient with sensorineural hearing loss without vertigo.
# ACR Appropriateness Criteria

## Variant 2: Sensorineural hearing loss, no vertigo.

<table>
<thead>
<tr>
<th>Radiologic Procedure</th>
<th>Rating</th>
<th>Comments</th>
<th>RRL*</th>
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<tbody>
<tr>
<td>MRI head and internal auditory canal without and with contrast</td>
<td>8</td>
<td>See statement regarding contrast in text under “Anticipated Exceptions.”</td>
<td>0</td>
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<tr>
<td>MRI head and internal auditory canal without contrast</td>
<td>7</td>
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<tr>
<td>CT temporal bone without contrast</td>
<td>5</td>
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<td>CT head without and with contrast</td>
<td>4</td>
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**Rating Scale:** 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

*Relative Radiation Level*
As part of his diagnostic workup, our index patient underwent an MRI with/without contrast of the head and internal acoustic canal. We will now see some of his images.
Our Patient: MRI

Minimally enlarged ventricles

Extra-axial mass:
- Tumor-parenchyma interface
- Surrounded by CSF
- No peritumoral edema

Homogenously enhancing Left CPA mass.

T1W MRI C+ (Coronal View)
Mass extends into porus acusticus and internal auditory canal (IAC).

Mass effect upon adjacent Brachium Pontis

Non-enhancing foci most likely secondary to cystic degeneration

T1W MRI C+ (Axial View)
Before we continue exploring our patient’s lesion, it is important to review some pertinent neuroanatomical landmarks. We will focus mainly in the cerebellopontine angle (CPA) region.
Companion Case #1: CPA Anatomy

The **Cerebellopontine Angle (CPA)** is a CSF-bathed space surrounded by the temporal bone, cerebellum and pons.

![Diagram of CPA](Gray's Anatomy)

![MRI Image](PACS, BIDMC)

**T1W MRI C- (Sagittal View)**
Companion Case #2: CPA Anatomy

CN VII & VIII exit brainstem at CPA. From there they enter the internal acoustic meatus (IAC).


SSFP MRI (Axial View)
The differential diagnosis for a CPA lesion is extensive. We will approach it by classifying the different etiologies according to their contrast-enhancing properties on MRI. We will subsequently differentiate the lesions according to their site of origin.

- Extra-axial lesion (from outside CNS)
- Intra-axial lesion (from within the CNS)
- Arising from skull base
Non-enhancing CPA lesions

Differential Diagnosis for CPA Lesions: MRI

Enhancing CPA lesions

- **Extra-axial**
  - Vestibular schwannoma: "Ice cream on cone" mass along nerve VIII
  - Trigeminal schwannoma: extends to Meckel's cave
  - Facial nerve schwannoma: extends to geniculate fossa
  - Mixed nerves schwannoma: extends to jugular foramen
  - Meningioma: broad base, hemispheric shape
  - Metastasis: associated multifocal lesions
  - Melanoma: spontaneous T1 hyperintense lesion
  - Sarcoidosis: hypointense on T2-WI, associated lesions
  - Tuberculosis: central T2 hypointensity, ring enhancement
  - Aneurysm: round, well-defined T2 hypointense lesion

- **Intra-axial and Intraventricular**
  - Lymphoma: T2 hypointensity, restricted diffusion
  - Glioma: enlarges brain stem, surrounded by edema
  - Metastasis: multiple lesions, peritumoral edema
  - Hemangioblastoma: solid or cystic with nodule, hypervascular
  - Medulloblastoma: low T2-ST, restricted diffusion, CSF spreading
  - Papilloma: hypervascular, extends through foramen of Luschka
  - Ependymoma: heterogeneous, extends through foramen of Luschka
  - DNET: heterogeneous, impinges adjacent bone

- **Skull Base**
  - Paraganglioma: "salt and pepper" appearance, flow voids
  - Chondromatous tumours: rise from synchodrosis, calcification
  - Chordoma: rises midline, destroys the clivus
  - Endolymphatic sac tumour: destroys retrolabyrinthine petrous bone

## Radiographic Features: Enhancing CPA Lesions

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<th>Extra-axial lesions:</th>
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<tr>
<td>• Surrounded by CSF</td>
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<td>• Enlarge CPA cistern</td>
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<td>• Displace brainstem and cerebellum</td>
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<th>Intra-axial lesions:</th>
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<tr>
<td>• Extensive peritumoral edema</td>
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<td>• Lack of brain-tumor interface</td>
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<th>Skull base lesions:</th>
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<td>• Associated bony erosions</td>
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Given that our index patient’s imaging showed radiologic findings consistent with an extra-axial lesion (i.e. contrast enhancement, a clear tumor-parenchymal interface and no peritumoral edema), the remainder of our discussion will focus on such lesions. Furthermore, it will emphasize the commonest lesion: vestibular schwannomas.

Vestibular Schwannomas: General Considerations

• Account for 80-90% of all CPA tumors
• Schwann cell-derived tumors most commonly arising from CNVIII
• Symptoms most commonly due to mass effect on adjacent posterior fossa structures
Vestibular Schwannomas: Clinical Findings

- **Sensorineural hearing loss**: 95% of patients
- Tinnitus: 65% patients
- Facial weakness or spasm: 17%
- If tumor is sufficiently large may affect lower cranial nerves (IX & X) causing dyshagia, aspiration and hoarseness.
- **Vertigo is uncommon** due to compensation in the setting of slow tumor growth.
Vestibular Schwannomas: Menu of Tests

• Magnetic Resonance Imaging (MRI)
  – Head and IAC MRI, +/- contrast
  – T1, MPRAGE, Heavily T2W, FLAIR
  – Gold standard for diagnosis and surgical planning.

• Computed Tomography (CT)
  – Head and IAC, + contrast
  – Useful for assessment of secondary bony changes.
  – Limited by artifacts
Companion Case #3: MRI

**Isointense mass in T1 MRI C-**

**Avid enhancement post contrast**

**T1W MRI C- (Axial View)**

**T1W MRI C+ (Axial View)**

Ice Cream Cone Sign
Companion Cases #4, 5: MRI

Large tumors may show cystic degeneration

Tumors appear hyperintense in T2W MRI


T1W MRI C+ (Axial View)

Hi Res T2W MRI C- (Axial View)
Companion Case #6: CT

CT is useful for assessment of skull base changes

- Bony erosion (not visible)
- Widening of IAM (Trumpeted IAM sign)

Limited by artifacts
- Streaking by petrous bone

Now that we have discussed some of the characteristic findings seen in vestibular schwannomas, let’s compare them to other CPA lesions.
Differential Diagnosis Revisited

• Meningiomas
  – Often extend to middle fossa
  – Hemispheric shape
  – Broad base attachment to petrous bone
  – Dural tail
  – Homogenous in appearance
  – Calcification more common
Differential Diagnosis Revisited

- Melanoma
  - T1 hyperintense
- Aneurysm
  - T2 hypointense
- Epidermoid/Dermoid Cysts
  - No post-contrast enhancement
References


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