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# Role of CT and MRI in Spectrum of Cerebropontine Angle Pathologies

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**AIM:**
- Describe the spectrum of pathologies of the CPA.
- Recognize the CT and MR imaging features of these lesions.

## I. Introduction:

Cerebellopontineangle(CPA) pathologies may arise from structures located within the cistern [subarachnoid space containing cranial nerves and vessels bathed in cerebrospinal fluid (CSF)] or from extension of lesions located primarily outside the cistern—from the brainstem, fourth ventricle, nerves and bony skull base. The symptoms and signs of CPA disease are non-specific, relating either to compression of the neural structures found within it or from compression of the fourth ventricle with resulting obstructive hydrocephalus.
Imaging is vital for diagnosis and management planning.
Computed tomography (CT) and conventional magnetic resonance (MR) imaging provides characteristics of the different CPA pathologies including anatomic site of origin, shape, density, signal and enhancement after contrast media injection.

## II. Material And Methods:

The current study is a prospective study conducted in the department of radio diagnosis at **GCS Hospital , Ahmedabad, includes 30 patients over a period of 24 months from January 2021 – December 2022, their imaging ( CT , MRI ) findings of "CEREBROPONTINE ANGLE PATHOLOGIES" done using GE Signa 1.5 tesla explorer and CT (Siemens emotion 16 slice MDCT) are assessed for evaluation of matter in interest.**

- **INCLUSION & EXCLUSION CRITERIA:**

**INCLUSION CRITERIA:**
**Patient who have sign and symptoms like headache, vomiting, loss of vision, decreased hearing, convulsive seizures, and ataxia.**

**EXCLUSION CRITERIA:**
- **Implanted electric and electronic devices are a strict contraindication to the magnetic resonance imaging, and in particular:**
- **heart pacemakers (especially older types)**
- **insulin pumps**
- **implanted hearing aids**
- **neurostimulators**
- **intracranial metal clips**

- **metallic bodies in the eye**
- **Metal hip replacements(old type), sutures or foreign bodies in other sites are relative contraindications to the MRI because they obscure the visualization of normal anatomy due to artifact effect.**
- **Pregnancy**

## ❖ IMAGING TECHNIQUE:

**Magnetic Resonance Imaging.**

MRI has excellent soft tissue contrast resolution and is the preferred imaging modality for differentiation and characterization of various soft tissues and fluids. In addition to conventional MR sequences of the brain, current imaging evaluation of the CPA includes high-resolution heavily T2-weighted imaging, such as constructive interference in steady-state (CISS), fast imaging employing steady-state acquisition (FIESTA) are helpful. Diffusion-weighted imaging (DWI) has been utilized for temporal bone and CPA imaging, particularly when abscesses or epidermoid/cholesteatoma are suspected.If there is suspicion for a vascular lesion in CPA ,two or three-dimensional time-of-flight techniques may be performed for arterial imaging without IVcontrast administration.

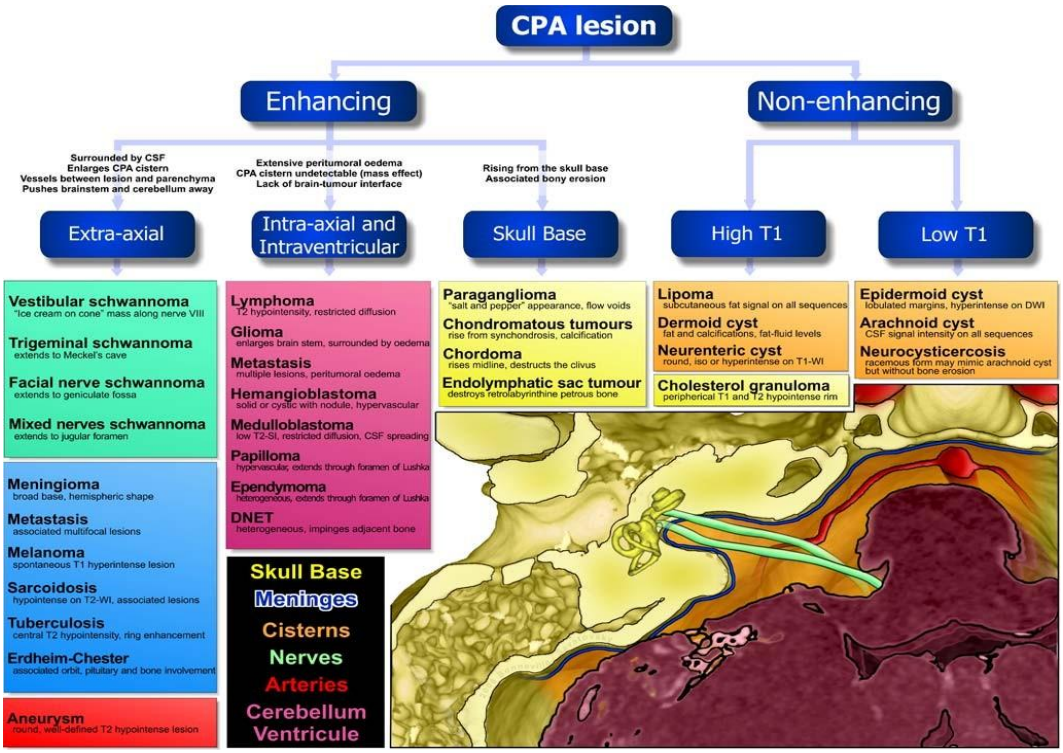
**Computed Tomography.**

CT is often performed for the evaluation of nonspecific clinical symptoms related to the CPA and posterior fossa and may initially identify culprit lesions. CT provides excellent definition of bone and air-filled spaces. The administration of intravenous iodinated contrast enables the identification of enhancing lesions and vessels and may increase lesion conspicuity.

At our institution, temporal bone and CPA imaging is performed with slices of 0.625 mm thickness, which are reconstructed with 0.3 mm interval, with high-quality multiplanar reformatted images.

## III. Results:

The approach for imaging depending on the result of a simple question: does the mass lesion enhance after contrast administration? If the answer is yes, the site of origin of the lesion is then determined as it leads to three different area based on whether the mass originates within the CPA cistern itself, the cerebellum or brain stem, or the skull base. If the answer is no, then the intrinsic T1 signal intensity is crucial: it points toward a cystic lesion if low, or a lesion with fat or a high protein content if high.

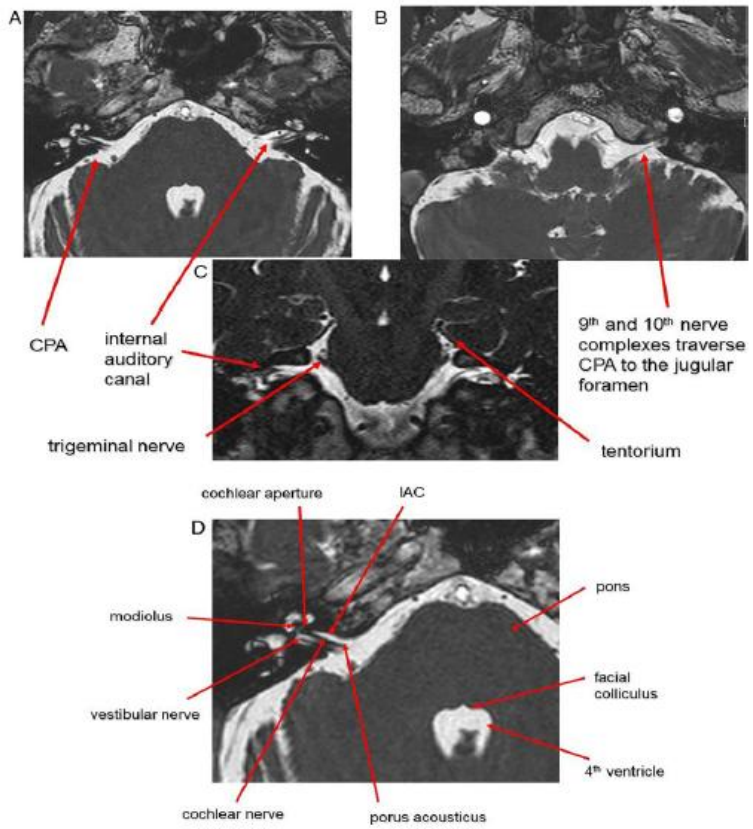



Drawing of a segmental approach to diagnosis of CPA lesions based on gadolinium enhancement, site of origin and key feature (adapted from reference [1]

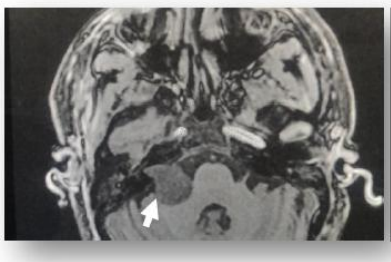
The cerebellopontine (CP) angle is bound anterolaterally by the posterior aspect of the petrous temporal bone and posteromedially by the cerebellum and pons. It contains important vascular structures and cranial nerves and is subject to a certain gamut of lesions, notably tumors with interesting radiological manifestations. Magnetic resonance is the imaging modality of choice for lesions of the CP angle and internal auditory canal. Lesions of the CP angles usually are divided into those native to the angle (vestibular schwannoma, meningioma, arachnoid cyst, epidermoid, metastases etc.) and those extending to the angle from adjacent structures (ependymomas, clival chordoma, vascular malformations).
Here we will see imaging of few major and important CP angle pathologies.

- **Vestibular schwannomas:**

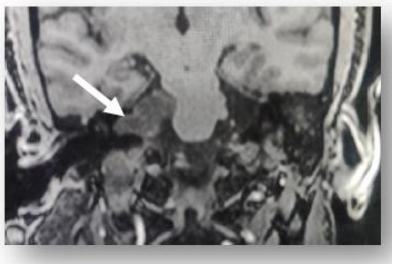
Vestibular schwannomas are by far the most important lesion of the CP angle, comprising 70%–80% of the lesions in this location. Most of these lesions develop from the Schwann cell within the IAC and as they grow extend out of the porus acousticus into the CPA.Three different MRI appearances of tumoral enhancement are described in vestibular schwannoma: Homogenous(50-60%), heterogenous (30-40%) and cystic (5-17%)[5-7].



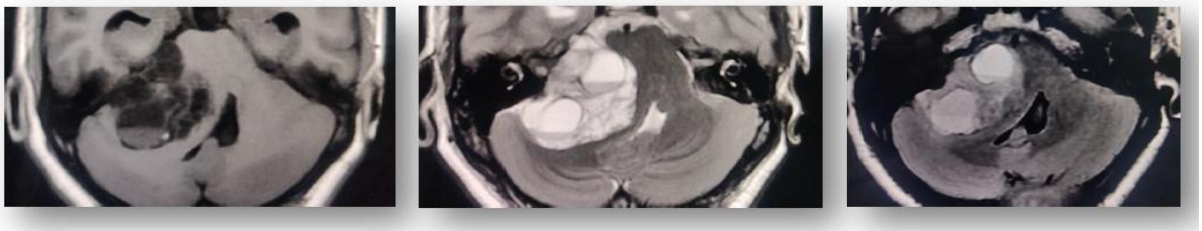

Normal anatomy: axial (A, B, D) and coronal (C) images of the cerebellopontine angle. CPA, cerebellopontine angle; IAC, internal auditory canal[3]



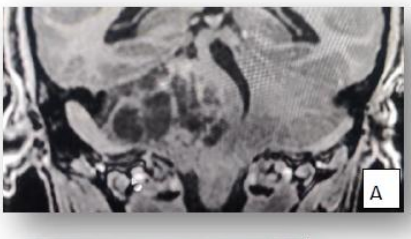
Vestibular schwannoma in patient with dizziness, right deafness and long-lasting headache. a Contrast- enhanced axial T1-weighted image shows typical "ice cream-on-cone" CPA mass lesion that heterogeneously enhances. The component enlarging the porus of the internal auditory canal is very suggestive of the diagnosis.

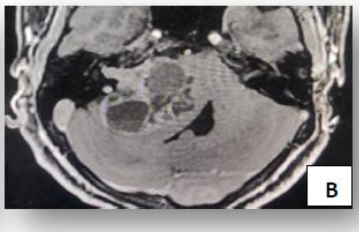


Cystic variety of vestibular →schwannoma.



Axial T1W, T2W and FLAIR image respectively showing fluid-fluid level within multiple cystic intensity lesion in right CP angle .

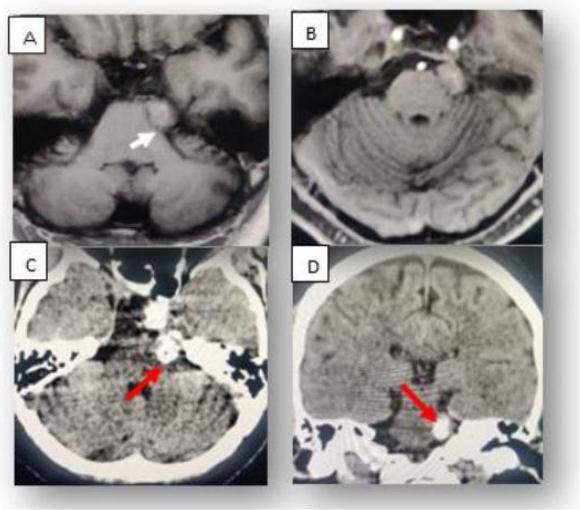



Contrast imaging coronal (A) and Axial (B) showing multiple cystic lesion and internal auditory component extension.


CT imaging of cystic variety of right sided vestibular schwannoma with internal fluid fluid level without any bony erosive changes ( Image C )

➢ **Meningioma :**Meningioma is the most common intracranial extra-axial tumour in adults, but is the second most frequent lesion in the CPA after vestibular schwannoma, representing 10%– 15% of all tumours in this location [7]. Meningiomas arise from arachnoid meningothelial cells and grow slowly in the CPA, independently from the internal auditory canal. They are usually located at the posterior aspect of the temporal bone or at the premeatal area, from where they can easily extend into the IAC, but without enlarging the porus [8,9]. At CT, meningiomas are hyperdense in 70% of the cases, calcified in about 20% (described in below image) .MRI clearly depicts a broad-based dural hemispheric or oval lesion, attached to the petrous dura mater or the inferior aspect of the tentorium. Meningiomas are usually isointense with the cortex on all sequences, and strongly enhance after contrast injection, often homogeneously. Though not specific to meningiomas [4], the intense enhancement of the non-neoplastic thickened peritumoral dura, the so-called "dural tail sign", is particularly frequent in association with meningiomas and should suggest the diagnosis when observed.

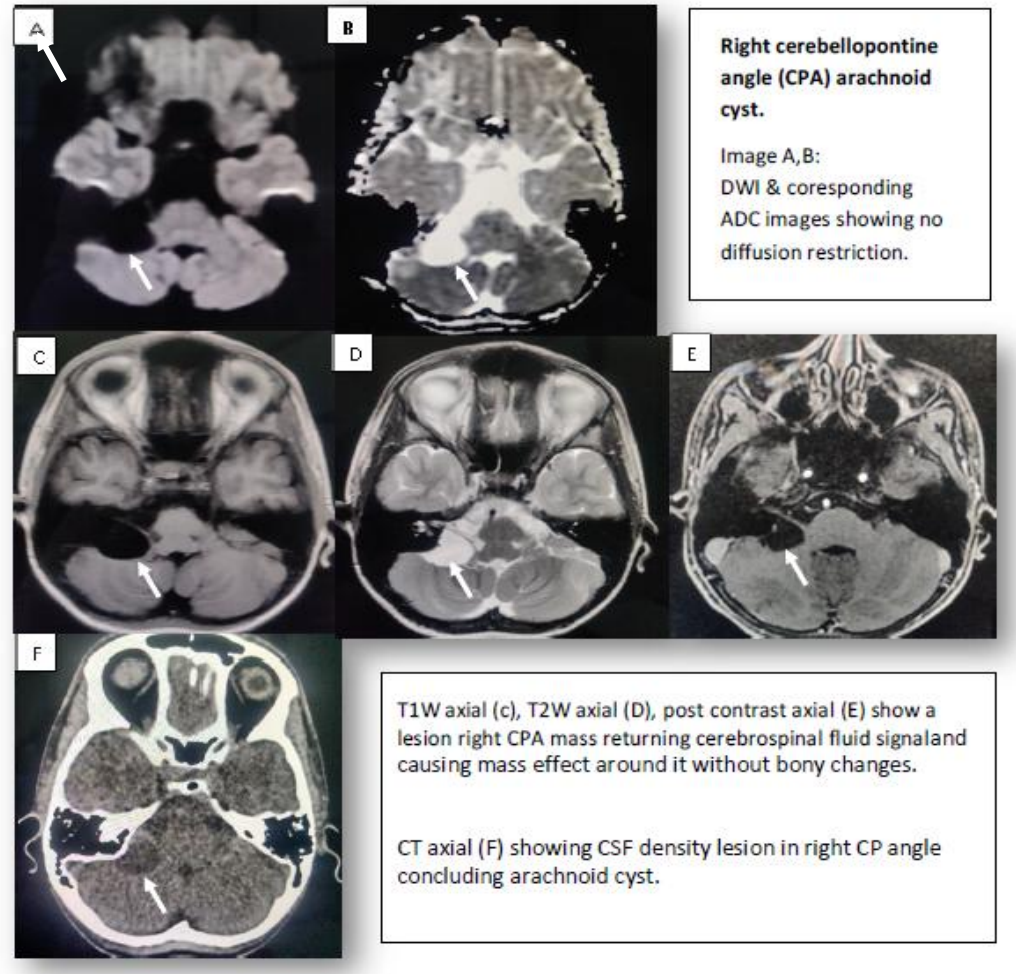



**Left CPA calcified meningioma .**
**A.** Axial T1W image reveals an homogeneous extra-axial isointense mass compressing the brain stem.Note the enostotic spur at the premeatal area ( white arrow), a feature suggestive of a meningioma.
**B.** Contrastenhanced axial gradient echo T1-weighted image shows an homogenous enhancing area.
**C,D**. Computed Tomography axial and coronal image showing extra axial calcified meningioma in left CP Angle. (red arrow)

➢ **Arachnoid cyst :**

Arachnoid cysts at all locations constitute 1% of all intracranial tumors, with a middle fossa location being more common than a posterior fossa location. The etiology of arachnoid cyst is unknown. They may be congenital and represent duplication of arachnoid . Symptoms referable to CP angle arachnoid cyst, such as hearing loss, tinnitus, imbalance, and hemifacial spasm (10), may be seen and could be intermittent.

CT usually shows a well-defined, nonenhancing lesions with CSF density. Large lesions may be associated with mass effect and bone remodeling. On MR, these lesions have intensity on T1-weighted and T2-weighted images, similar to CSF.




**Right cerebellopontine angle (CPA) arachnoid cyst.**

Image A,B:
DWI & coresponding ADC images showing no diffusion restriction.

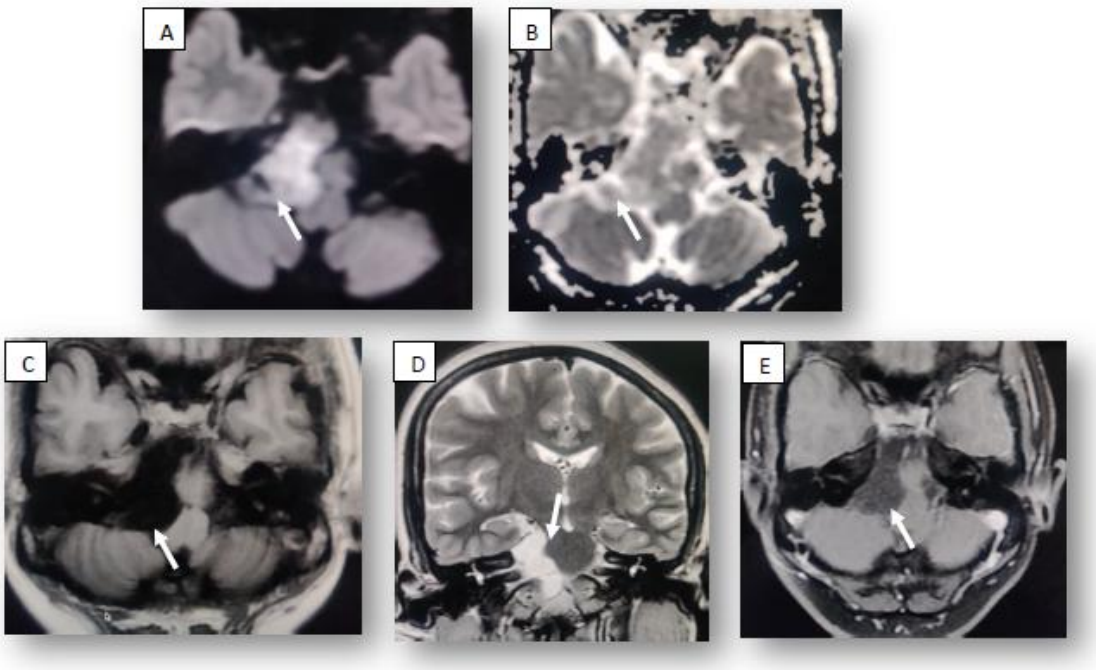
T1W axial (c), T2W axial (D), post contrast axial (E) show a lesion right CPA mass returning cerebrospinal fluid signaland causing mass effect around it without bony changes.

CT axial (F) showing CSF density lesion in right CP angle concluding arachnoid cyst.

➢ **Epidermoid cyst :**

Epidermoids are the third most common lesions of the CP angles and account for up to 9% of these tumors. They are embryonal lesions arising from multipotential cell. e. These lesions usually are found in patients between the ages of 20 and 60 years. They are slow-growing lesions that burrow into crevices of the brain and surround and infiltrate cranial nerves and vital posterior fossa vasculature. Pathologically, epidermoids are composed of desquamating squamous epithelium surrounded by a capsule. The desquamated epithelium converts into keratin and cholesterol lipids.

The radiological appearance of an epidermoid reflects the composition of the lesion[11].Diffusion-weighted images may be helpful for differentiating epidermoid cyst ( which are bright on DWI) and arachnoid cyst (which doesn't show diffusion restriction.)




**Right cerebellopontine angle (CPA) epidermoid cyst.**

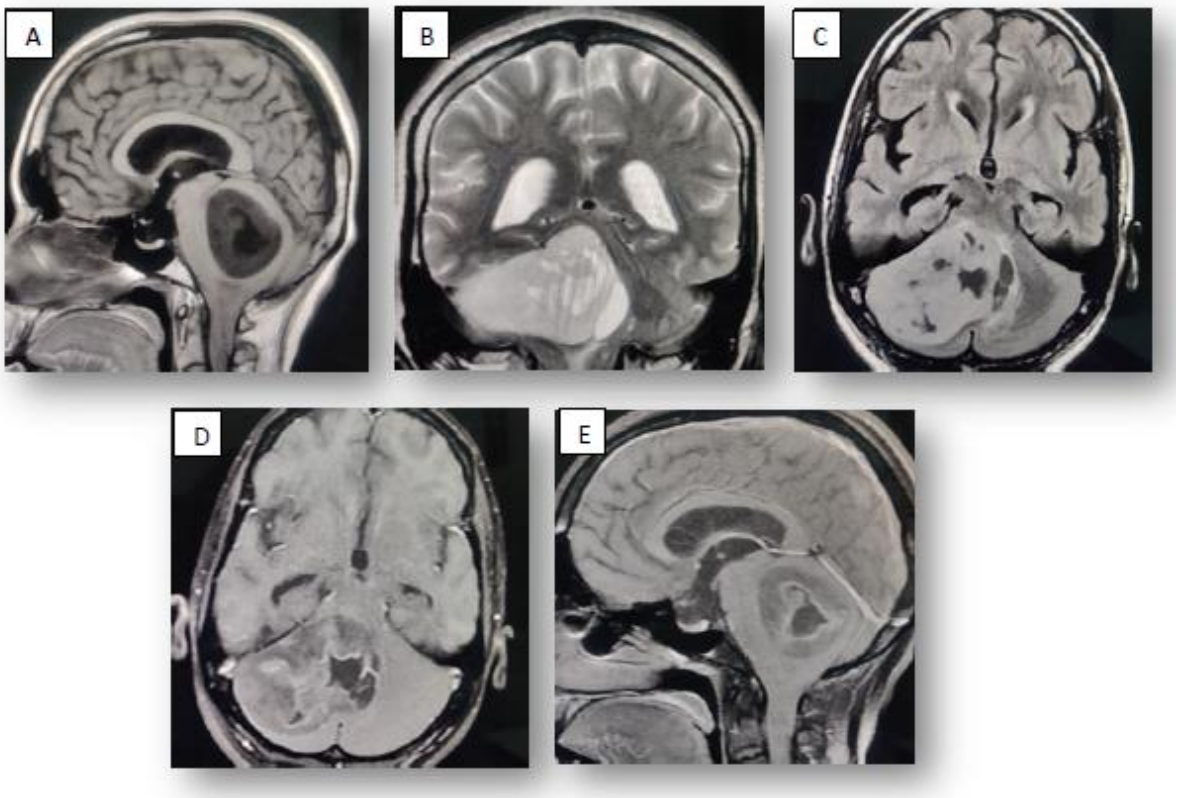
DWI with apparent diffusion coefficient( A, B) Showing right CP angle with diffusion restriction. T1W axial (c), T2W coronal (D) and Post contrast axial (E) MRIs show a T1-hypointense, T2-hyperintense , Non enhancing on post contrast study the lesion of right CPA lesion, compressing the right middle cerebellar peduncle and brain stem .

➢ **Extension of intra-axial posterior fossa pathology-Ependymoma :**

Common posterior fossa brain tumors in children include juvenile pilocytic astrocytoma (JPA), medulloblastoma (MB), ependymoma, and brainstem glioma.

Ependymomas are the fourth most common posterior fossa tumors in children and constitute approximately 8–15% of the neoplasms[13]. In children, ependymomas are more frequent infra- than supratentorial (70% versus 30%, respectively) and more commonly intracranial than intraspinal [14]. Ependymomas usually arise in the fourth ventricle and fill the cavity of this ventricle.

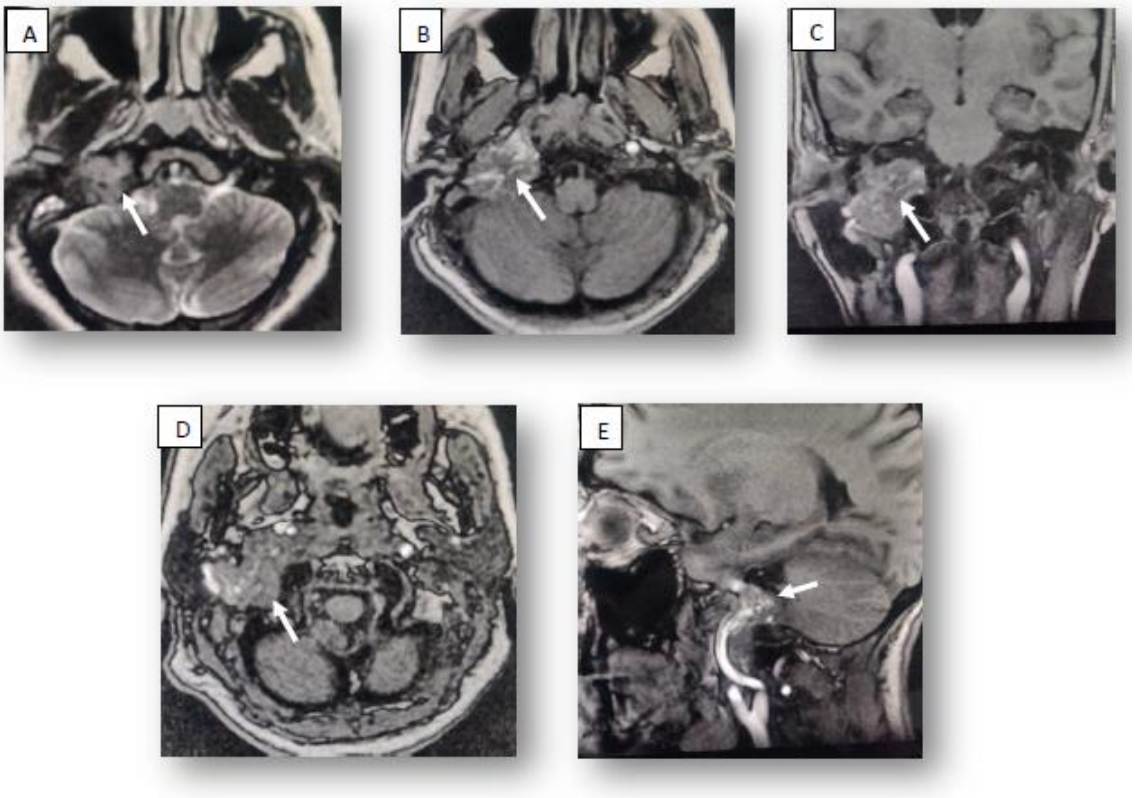
A typical feature of ependymomas is the tendency to extend via recesses of the fourth ventricle into adjacent regions. Thus, extension via lateral recesses of the ventricle gives them access to the CP angles. The diagnosis under these circumstances is not difficult. One sees a fourth ventricular tumor with features typical of ependymomas with a component in the CP angle.




**Ependymoma.**
A. T1W sagittal image showing hypointense lesion in 4rth ventricle.The lesion appears heterogeneously hyperintense on T2W coronal and FLAIR image(B,C)
Gadolinium-enhanced axial T1-weighted axial and sagittal(D,E) shows heterogenous enhancement.

- **Vascular - Glomus jugulare Paraganglioma.**

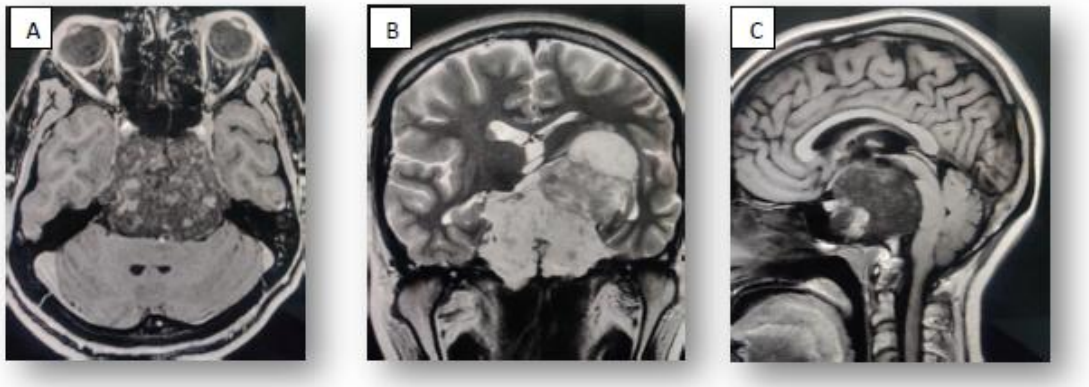
Lesions affecting the jugular foramen may extend into the CPA. Most paragangliomas located in the CPA result from the extension of paragangliomas arising at the jugular foramen (glomus jugulare tumour) or in the middle ear (glomus tympanicum tumour) [3]. It is the glomus jugulare subtype that is most likely to involve the CPA. These benign but locally aggressive tumours destroy the bones of the skull base with a moth-eaten erosion pattern at CT. At MRI, paragangliomas appear as highly vascular soft tissue lesions demonstrating a mix of multiple punctuate and serpentine signal voids corresponding to high-flow intratumoral vessels and foci of high-signal intensity due to intratumoral hemorrhages with methemoglobin, producing the characteristic salt-and-pepper appearance [14]. On MRI, these lesions are hypointense on T1, hyperintense on T2, and enhance with gadolinium.




**Glomus jugulare- Paraganglioma.**
A. Axial T2-weighted image shows a voluminous hypointense mass lesion widening the right CPA cistern with internal few flowvoid.
B.Gadolinium-enhanced axial T1-weighted axial and coronal (C) image , angiography ( D,E) better depicts the extent of the tumour in the skull base and the jugular foramen it comes from.

- **Chordoma:**

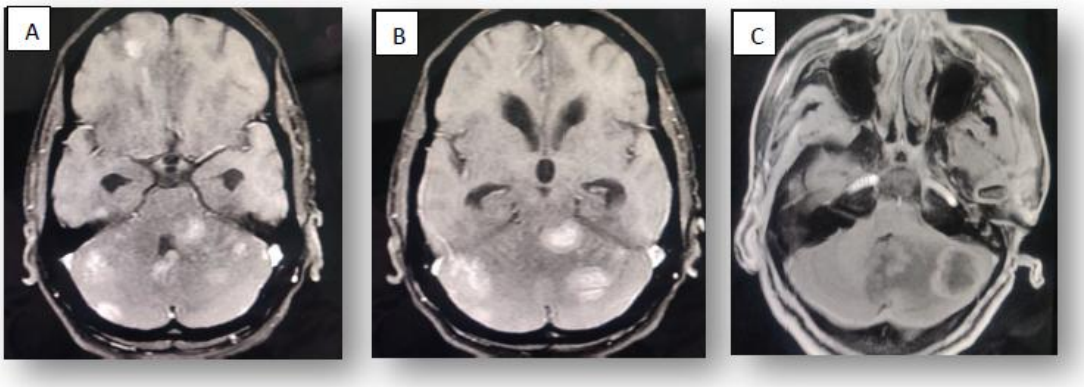
Less commonly, tumors from adjacent non-neural anatomic structures can invade the CPA. Clival chordoma represent the second commonest site of chordoma (sacrococcygeal location being the first location). Chordomas are uncommon malignant tumors that account for 1% of intracranial tumors and 4% of all primary bone tumors.They originate from embryonic remnants of the primitive notochord (earliest fetal axial skeleton, extending from the Rathke's pouch to the coccyx). Since chordomas arise in bone, they are usually extradural and result in local bone destruction. They are locally aggressive.[15]




**Chordoma.** T1W axial (A),T2W coronal (B), T2W sagittal (C) MRIs show a large midline mass destroying the clivus . Tumour extends into the pontine cistern and cerebellopontine angle , also superiorly extending left temporal region. Chordomas are typically T2 hyperintense and demonstrate foci of T1 hyperintensity within

- **Metastasis:**

Meningeal metastases from lung or breast cancers, melanoma may invade the CPA. At imaging, the presence of multifocal cerebral lesions is highly suggestive of metastases , but CPA metastases may be solitary and mimic benign tumours of the CPA [16], or be bilateral, mimicking neurofibromatosis 2 [17]. Metastases from cutaneous melanomas certainly represent the most frequent aetiology of melanocytic tumours in the CPA [18].




**Metastasis.**
A,B. T1W axial images shows multiple intra -axial metastases with lung cancer. C. Contrastenhanced axial T1-weighted image demonstrates peripherally enhancement as target sign suggestive of a metastasis

## IV. Conclusion :

Lesions of the CPA represent 10% of intracranial neoplasms. More than 80% of these are cranial nerve schwannomas. Meningiomas and epidermoids are the next most common followed by a potpourri of other lesions. Focused attention to a patient's clinical history and imaging studies, will often support a particular diagnosis. Treatment may include observation, microsurgical resection, sterotactic radiation, or multimodality therapy.

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