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A Case Series of MRI Features of Adult and Childhood Posterior Fossa Tumors

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ABSTRACT
Objective: *The goal of this pictorial essay is to help the radiologist have a refined approach to formulating an appropriate differential diagnosis for paediatric and adult primary posterior fossa masses.*
Materials and Methods: *This pictorial essay will review posterior fossa masses in both adult and paediatric patients seen at our institution for the past 3 months. it was an observational cross sectional study. the sample size was 100. Those cases with symptoms related to posterior fossa such as vertigo, imbalance, nystagmus, difficulty in gait were included in the study. the study population included both adult(60 cases) and pediatric case(40 cases)*
Results: *We got a spectrum of cases of posterior fossa lesions .predominant lesions noted in the pediatric population were ependymoma and medulloblastoma. the adult cases that were encountered were acoustic schwannoma, epidermoid cyst, intraventricular meningioma, cysticglioma.*
The posterior fossa masses are presented in 2 categories: paediatric, adult. Distinguishing MR imaging features and demographics are discussed for each mass, with select cases reviewing uncommon and atypical appearances.
Conclusion: *Posterior fossa masses are a relatively common finding for radiologists. In some cases, it can be difficult to definitively diagnose these masses by using imaging findings alone.*
However, posterior fossa masses often preferentially present in specific age groups and have characteristic MR imaging findings, which can either help formulate the correct diagnosis or significantly narrow the working differential diagnosis.
Keywords: *posterior fossa mass, MRI, adult, children.*

Introduction

The posterior fossa extends from the foramen magnum to the tentorium cerebelli.

Masses in the posterior fossa often cause direct or indirect effect on the cerebellum or brain stem, resulting in predictable signs and symptoms. Although the number of possible primary posterior fossa masses is large, the differential diagnosis for any such lesion can be significantly narrowed by using the imaging characteristics and

patient demographics. Determining whether the mass is intra-axial versus extra-axial should be the first dividing point.

The age of the patient is also important because the prevalence of each posterior fossa mass largely differs with age. The posterior fossa is the most common location for primary pediatric intracranial neoplasms, comprising 50%–55% of all primary intracranial masses in children.[1]

Medulloblastomas, pilocyticastrocytomas, brain stem gliomas, and ependymomas are largely thought of as pediatrictumors and are rarely seen in adults. In adults, extra-axial masses, such as schwannomas and meningiomas, are the most common primary posterior fossa masses.

Pediatric Posterior Fossa Masses

Most intracranial masses in the pediatric population are located in the posterior fossa. Medulloblastoma and pilocystic astrocytoma are the most common followed by brain stem glioma and ependymoma.

Medulloblastoma/PNET

Infratentorial PNETs, commonly referred to as medulloblastomas, are the most common primary pediatric neoplasms of the posterior fossa. They represent 12%–25% of allpediatric CNS tumors and 38% of pediatric posterior fossa masses.[2,3.]

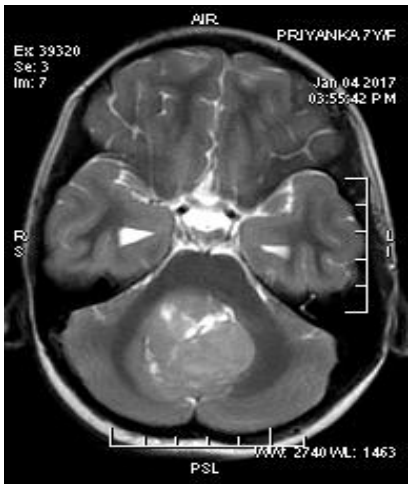
Most medulloblastomas occur in children younger than 10 years of age, with 2 small peaks at 3 and 7 years[2]. Medulloblastomas are usually aggressive, with most patients having symptoms for 3 months before diagnosis. The classic symptoms include headache, truncal ataxia, and sixth cranial nerve palsy[2-4]. Medulloblastomas are most commonly found in the cerebellum, with most arising from the superior medullary velum, which is the roof of the fourth ventricle[2]. The likelihood of finding these tumors in the cerebellar hemisphere increases in older children and adults.

More than half (59%) of medulloblastomas have cysts, and occasionally there are calcifications (22%) and foraminal extension (14%).[5]. On MR imaging, medulloblastomas are typically iso to hypointense on T1WI and variable on T2WI (Fig 1A and B) .[6,7]

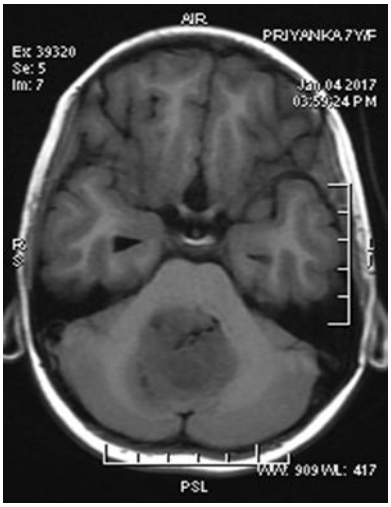
MR imaging shows that there is heterogeneous enhancement with contrast .[2]Medulloblastomas have restricted diffusion, with increased signal intensity on DWI (Fig 1D) and corresponding low ADC values.

Low ADC values can help differentiate medulloblastomas from other less cellular masses, such as ependymomas and juvenile pilocytic astrocytomas.[8]

One study by Rumboldt et al [8] found that ADC values <0.9x10 [3]mm2/s are highly specific for medulloblastomas when differentiating pediatric cerebellar tumors. When working up a medulloblastoma, the entire spine should be imaged to evaluate for drop metastasis.



1A



1 B

Fig 1A and 1B T1 and T2 W images showing hypointense T1 mass arising from the cerebellar vermis compressing the 4 th ventricle anteriorly the fourth and hyperintense mass in T2

Ependymoma

Ependymomas arise from ependymal cells that line the cerebral ventricles. Fifty-eight percent of all ependymomas are located in the fourth ventricle.[11]

Although ependymomas can occur at any age, most of the posterior fossa ependymomas occur in children with a mean age of 6 years.[11]

Patients with fourth ventricle ependymomas often present with ataxia and paresis, which are largely due to the effects of the resulting increased intraventricular pressure and hydrocephalus.[4,11]

On CT, ependymomas are isoattenuating lesions that have intense but variable contrast enhancement, with 40%–80% containing calcifications.[11,12]

The calcifications vary in size and may be punctate foci or large and masslike. Occasionally there is hemorrhage seen within the tumor.[13]

On MR imaging, intraventricular ependymomas are heterogeneous due to the calcifications and hemorrhage, with an overall isointense appearance on T1WI (Fig 2B) and hyperintense appearance on T2WI (Fig 2A) [11,13]

Due to their low cellularity, ependymomas have a high ADC value (>1.1x10^{3}mm2/s), which can help differentiate them from medulloblastomas.[8]

Imaging of the fourth ventricle ependymomas often shows extension through the foramen of Luschka into the cerebellopontine angle cistern or foramen magnum [11]

Spread of ependymoma cells into the CSF is an important factor in staging and treatment; therefore, the entire spine should be imaged to evaluate for drop metastasis

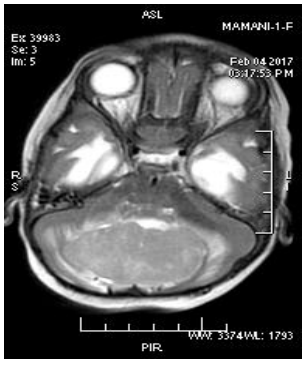


Fig 2A. T2W image shows hyperintense mass filling the fourth ventricle with obstructive hydrocephalus.

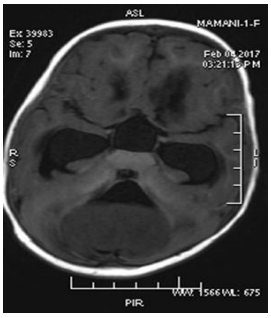


Fig 2B. T1W image shows hypointense mass

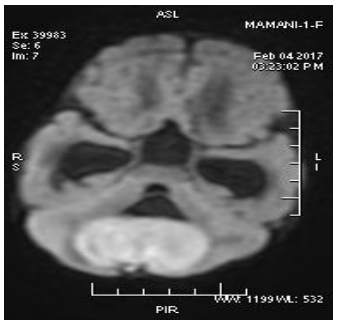


Fig 2C. DWI shows the restricted diffusion suggesting high cellularity

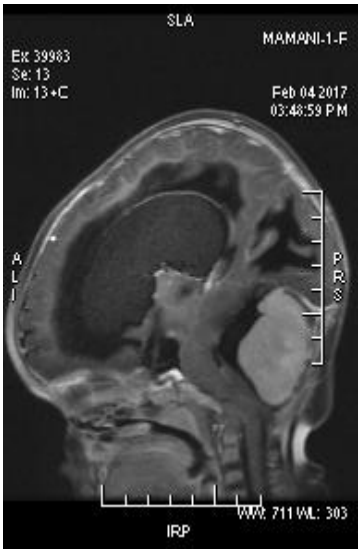


Fig 2D. SAG FS post contrast shows homogenously enhancing mass

Adult Extra-Axial Posterior Fossa Masses

Posterior fossa masses are much less common in adults compared with children. The first step in characterizing an adult posterior fossa mass is to determine whether it is intra- or extra-axial. Unlike in the pediatric population, Vestibular Schwannoma

Vestibular schwannomas are benign nerve sheath tumors of CN VIII that account for the large majority of cerebellopontine angle masses in

adults.[15]

There is a known association with NF-2 and MISME (Multiple Inherited Schwannomas, Meningiomas and Ependymomas) syndrome. Bilateral vestibular schwannomas are diagnostic of NF-2. Larger vestibular schwannomas are also associated with concomitant most adult posterior fossa masses are extra-axial. arachnoid cysts, seen in up to 10% of cases.[4]

Due to their effect on CN VIII, vestibular schwannomas often present with vertigo, tinnitus, or hearing loss.4.Schwannomas track along nerves and can have expansile effects on adjacent bones or foramina. Although some vestibular schwannomas are only seen in the internal auditory canal while others are only in the CPA cistern, the large majority have both an intracanalicular and extracanalicular component.4

The classic appearance is often described as resembling an ice cream cone, with the CPA cisternal portion representing the ice cream and the internal auditory canal portion representing the cone. On CT, schwannomas are well-delineated is attenuating lesions that enhance with contrast. [4,20]

On MR imaging, schwannomas are isointense-to-slightly-hypointense on all sequences, with strong contrast enhancement.(Fig 3A,B,E)[4,20]

Schwannomas are often difficult to differentiate from meningiomas on CT or MR imaging; however, there are several clues that can help favor one lesion over the other. Calcifications or dural tails should strongly favor meningioma over schwannoma. [4,14]

On the other hand, dilation of the internal auditory canal is suggestive of schwannomas.[4,14]

T2* GRE sequences can show focal hypointense punctate areas of microhemorrhage (Fig 3C); however, these can have an appearance similar to that of punctate calcifications seen in meningiomas

Schwannomas can occur along any cranial nerve but are most common on CN VIII, followed by CN VII and CN V, respectively.[4]

A common site for oculomotor (CN III) Schwann-omas is within the interpeduncular cistern.[16]

As expected, they have the same imaging characteristics as CN VIII schwannomas but present with different symptoms.

Fig 3A-3C

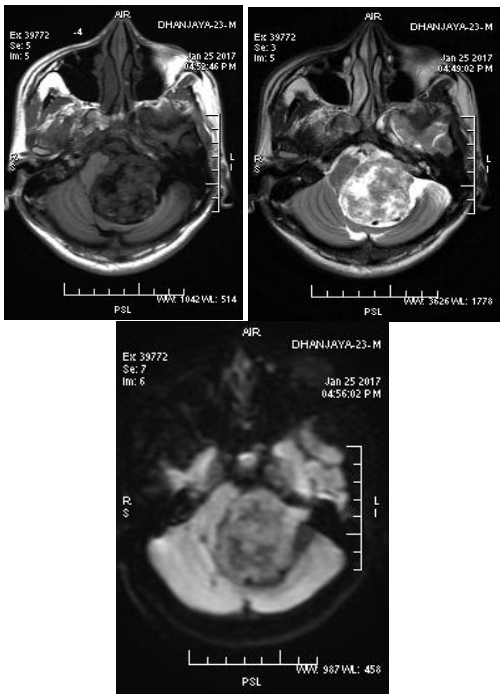
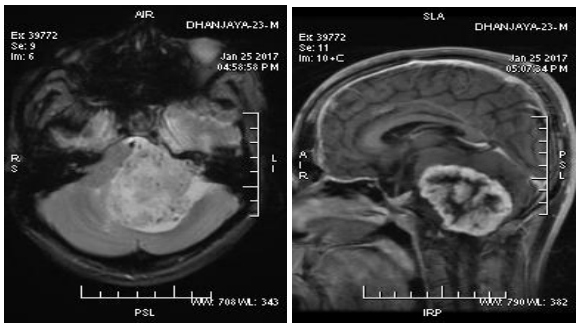


Fig 3A.axial T1W image shows iso to hypoin-tense extra axial mass in the left CP angle cistern

Fig 3B.axial T2W image shows iso to hyperintense areas with widening of the left internal acoustic canal

Fig 3C. DWI shows no significant diffusion restriction noting low cellularity

Fig 3D,3E



From left to right

Fig 3D. GRE image shows small microhemorrhages in the tumor

Fig 3E.Sag T1 W contrast shows heterogenous intense contrast enhancement

Epidermoid Cyst

Epidermoid cysts arise from the inclusion of

epithelial cells during neural tube closure. They contain keratin and cholesterol produced by the desquamation of these epithelial cells.[4,14]

The peak incidence is between 20 and 40 years of age.[4]

In the posterior fossa, they often occur in the CPA cistern or prepontine cistern and are generally slow-growing tumors that encase and surround adjacent nerves and vessels. On CT, they have low attenuation that is almost isointense to CSF. Epidermoid cysts can easily be mistaken for arachnoid cysts on CT; however, the lobulated and irregular margins of epidermoid cysts may help differentiate them. Alternatively, MR imaging can more definitively differentiate the 2 masses, with DWI and FLAIR being the most helpful sequences. On MR imaging, epidermoid cysts usually have slightly higher signal intensity than CSF on both T1- and T2-weighted sequences and rarely enhance (Fig 4A,B,C). High signal intensity on DWI sequences can definitively distinguish an epidermoid cyst from an arachnoid cyst (Fig 4D).[14]

In addition, on FLAIR sequences, arachnoid cysts follow CSF signal intensity, where a sepidermoid cysts do not show complete signal suppression.

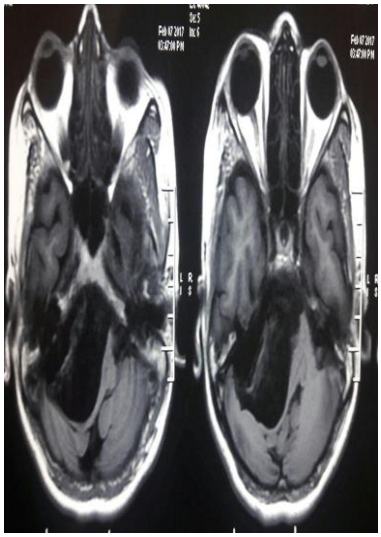


Fig 4A.T1W image shows hypointensecystic lesion with lobulated contour and dirty CSF appearance

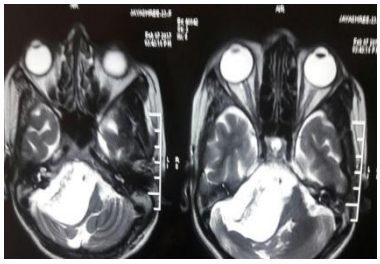
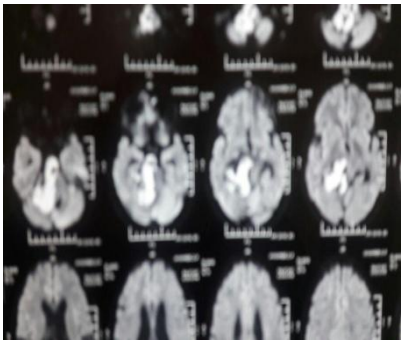


Fig 4C.T2W image shows CSF signal within the lesion



Top To Bottom

Fig 4D.DWI shows diffusion restriction in the lesion

Cystic Ganglioglioma Posterior Fossa

Gangliogliomas are rare primary intracranial lesions that are composed of differentiated ganglion and glial cells.[17]

Most occur in patients younger than 30 years of age, with a peak between 10 and 20 years. This mass could have been included in the pediatric section but instead was placed in the adult intra-axial section to remind readers to consider this lesion in young adults. Gangliogliomas are thought to have a low malignant potential and usually have a benign clinical course.[17,18]

They are more commonly supratentorial but are also found in the cerebellum and brain stem.[17]

Gangliogliomas are often not diagnosed until after surgery due to their variable appearance and inconsistent enhancement pattern on CT and MR imaging. They can appear purely cystic (5%), mixed cystic solid (52%), or solid(43%).[18]

On nonenhanced CT, gangliogliomas are most frequently low-attenuating masses but can also be iso-,mixed-, or high-attenuating.[17-19]

The MR imaging features are also variable and nonspecific; however, they are most commonly

iso- to hypointense on T1WI (FIG 5A) and have high signal intensity on T2WI (Fig 5B) .[17-19]

The enhancement patterns on CT and MR imaging are inconsistent but may have slight wall enhancement of the cystic component[17-19]

There is usually little or no vasogenicedema or mass effect, but calcifications are occasionally seen. [17-19]

Fig 5A Fig 5B

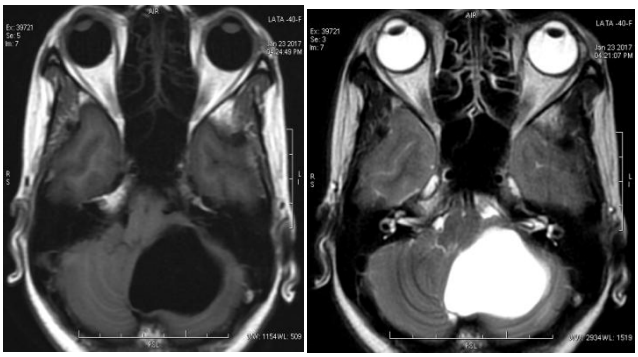


Fig 5A.T1W image shows a well defined cystic lesion in the left cerebellar hemisphere with no peritumoraledema.

Fig 5B.T2W image shows hyperintense lesion with CSF intensity contents

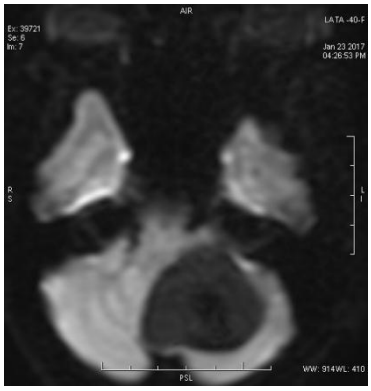


Fig 5C Fig 5D

Left to Right

Fig 5C.DWI shows no diffusion restriction

Intraventricular Meningioma

First described by Sachs in 1983 [(9),] primary fourth ventricle meningiomas are extremely rare, with only 28 cases reported in the literature describing these tumors.. Abraham et al. [(1)] classified posterior fossa meningiomas without dural attachment as Type I: meningiomas that arise from the choroidal plexus of the fourth ventricle and lie entirely in it, Type II: meningiomas that arise from the inferior telachoroidea and are located in both the fourth ventricle and cerebellar hemisphere, and Type III: meningiomas located in the cisterna magna. Fourth ventricle meningiomas correspond to the Type I of this classification. These tumors have slight female predominance. Reviewing the cases in the literature, including our case, 67% of patients were female and 33% were male, with sex ratio of 2:1 female to male. The average age of the patients was 45 years, ranging from 14 to 72. However, the age of the female patients was younger (mean = 36.9 years old) compared to male patients (mean = 60 years old).

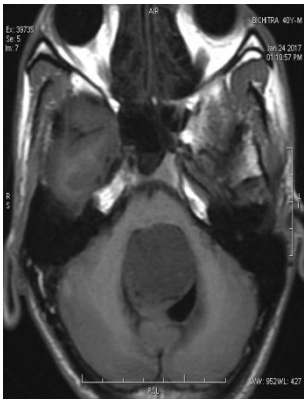


Fig 6A.AX T1 W image shows isointense well defined mass in the 4 th ventricle

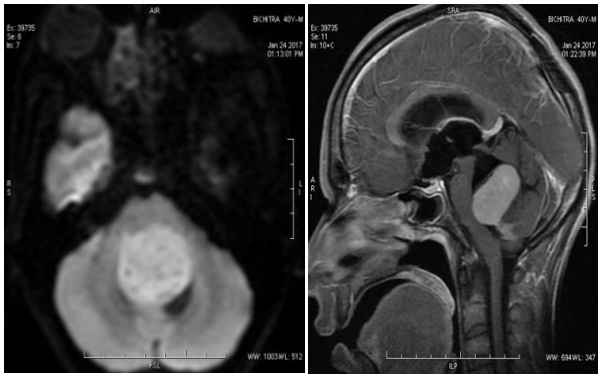


FIG 6A-D

Left to Right

Fig 6C.Diffusion weighted image shows mild diffusion restriction

Fig 6D.SAG and AX T1 FS C+ image shows homogenous enhancement of the mass.

Conclusion

Posterior fossa masses are a relatively common finding for radiologists. In some cases, it can be difficult to definitively diagnose these masses by

using imaging findings alone. However, posterior fossa masses often preferentially present in specific age groups and have characteristic MR imaging findings, which can either help formulate the correct diagnosis or significantly narrow the working differential diagnosis.

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