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Research Article

# ROLE OF MAGNETIC RESONANCE IMAGING IN THE EVALUATION OF POSTERIOR CRANIAL FOSSA SPACE-OCCUPYING LESIONS

**SABINA SHAMS, BASER SC, RUMANA HITAWALA***

**[1]Department of Radiology and Imaging, Medanta Hospital, Gurgaon, Haryana, India. [2]Department of Radiology, Geetanjali Medical College and Hospital, Udaipur, Rajasthan, India. [3]Department of Radiology, American Institute of Medical Science, Udaipur, Rajasthan, India. *Corresponding author: Rumana Hitawala; Email: rumanaht@gmail.com**

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**ABSTRACT**

**Objectives:** The current study was conducted with the objective to evaluate and characterize various posterior cranial fossa space-occupying lesions as solid, cystic, vascular, and infective. The current study aims to evaluate this and to help clinicians with early detection, exact site, and extent of the lesion.

**Methods:** A Cross-sectional study was conducted over a period of 18 months (January 2021 to June 2022) in patients who were clinically suspected and who underwent magnetic resonance imaging to evaluate posterior fossa space-occupying lesions at Geetanjali Medical College and Hospital, Udaipur.

**Results:** In our study, the most common posterior fossa space-occupying lesion was acoustic neuroma (12, 2l.82%) followed by arachnoid cyst (7, 12.73%). The most common space-occupying lesion in female patients was acoustic neuroma (7 patients, 30.43%) whereas in male patients, the most common space-occupying lesion was arachnoid cyst (6, 18.75%). There were almost equal numbers of intra (49.09%) and extra-axial cases (50.91%).

**Conclusion:** Due to the restricted space, involvement of the crucial brain stem nuclei, and fourth ventricle, posterior fossa space-occupying lesions are regarded as critical brain lesions. Early diagnosis and treatment are now possible thanks to modern diagnostic and therapeutic modalities.

**Keywords:** Magnetic resonance imaging, Posterior cranial fossa space-occupying lesions, T1WI, T2WI, Fluid attenuated inversion recovery.

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## INTRODUCTION

The posterior cranial fossa comprises all the space below the tentorium cerebelli and above the foramen magnum.

Vital structures such as the brainstem, cranial nerves (CVII-CXII), vertebrobasilar vessels, and venous sinuses are presented in the posterior cranial fossa.

Posterior cranial fossa space occupying lesions can be categorized as:

- Tumors-Acoustic Schwannoma, Meningioma, Epidermoid, Medulloblastoma, Pilocytic Astrocytoma, Brainstem Glioma, Cerebellar Hemangioblastoma, Ependymoma, Metastasis
- Infections-Tuberculomas, NCC, Abscess
- Tumor Mimics-Arachnoid cyst, Dandy-walker cyst [1].

The clinical presentation depends on the site, biological behavior, and the rate of growth of the lesion. The patient usually presents with severe headache or frequent vomiting due to associated hydrocephalus which are usually due to compression of the cerebellum or brain stem and increased intracranial pressure [2].

Magnetic resonance imaging (MRI) has a high sensitivity for detection and determining the extent of disease process because of its better soft-tissue resolution, multiplanar capability, and ability to obtain complementary information with T1- and T2-weighted images [3].

On MRI a near symmetric distribution in the intra- and extra-axial compartment is seen. In the intra-axial compartment, cerebellum was the most common site involved followed by the fourth ventricle. In the extra-axial compartment CP angle, a cistern is involved in nearly all cases [4].

MRI is also helpful to know the secondary effects of the lesions on the adjacent neuroparenchyma, cranial nerves, and ventricular system, which are of great importance because the posterior fossa has extremely limited space.

MRI is a golden tool to characterize posterior cranial fossa space-occupying lesions as it helps characterize the lesion, differentiate malignant from benign lesions non-invasively, and detect complications to adjoining brain parenchyma thereby causing great impact on planning of management.

## METHODS

### Study design

A cross-sectional study was conducted over a period of 18 months (January 2021 to June 2022) in a minimum of 50 patients who were clinically suspected a case of posterior cranial fossa space-occupying lesion and underwent MRI at Geetanjali Medical College and Hospital, Udaipur. Scanning was done with MRI 3 (SIGNA ARCHITECT)/1.5-tesla machine (SIEMENS MEGNETOM AVANTO). Precontrast scanning was done using T1WI, T2Wl, Fluid attenuated inversion recovery (FLAIR) (axial, sagittal, and coronal), GRE, and post-contrast T1WI multiplanar imaging. Special MRI sequences, such as magnetic resonance spectroscopy and perfusion imaging were obtained as and when needed.

### Inclusion criteria

Adults (>18 years), only those patients who wanted to participate in the study were included, all cases with clinical symptoms of posterior cranial fossa space-occupying lesions and already diagnosed cases.

### Exclusion criteria

MRI contraindicated patients (such as those with a cardiac pacemaker, who had an allergy to previous contrast study, and claustrophobic patients), patients not wanting to participate in the study, all patients who have been operated on were not included, and patient with recurrence were also not included.

### Method

Purposive sampling method of study: Details of the study protocol were explained to the subjects, Informed consent obtained, and routine MRI protocol was done on a 3 T/1.5 MRI machine.

### Statistical analysis

The data were entered in MS Excel Software version 20 and analyzed using Statistical Package for the Social Sciences, IBM Comp, version 21. Descriptive analysis of the data was performed presenting the results as frequency and percent for qualitative variables and as mean and standard deviation for age. The relation between qualitative variables was evaluated by the Chi-square test and Fisher's exact test if needed. The quantitative data were analyzed using an independent Student's t-test. $p<0.05$ was considered statistically significant.

## RESULTS

The study was conducted on 55 (Table 1) patients who were referred to the Radiology department of GMCH, Udaipur for an MRI examination of the posterior fossa space-occupying lesion.

The most common symptom identified in patients was headache (29.09%) followed by vomiting (16.36%), fever and seizures (10.91%), ataxia (9.09%), general weakness, hearing loss, tinnitus, visual disturbances and imbalance in 5.45% each.

In our study, the most common posterior fossa space-occupying lesion was Acoustic neuroma (12, 21.82%) followed by arachnoid cyst (7, 12.73%), Metastasis (6, 10.91%), Meningioma (5, 9.09%), Hemangioblastoma and Epidermoid cyst (4, 7.27%), medulloblastoma, brainstem glioma and tuberculoma in 3 (5.45%), and abscess, ependymoma in 2 (3.64%) each.

The most common space-occupying lesion in female patients was acoustic neuroma (7 patients, 30.43%) followed by hemangioblastoma and metastasis (3 patients, 13.04% each). In male patients, the most common space-occupying lesion was an arachnoid cyst (6, 18.75%) followed by acoustic neuroma (5, 15.63%), meningioma (4, 12.50%), epidermoid cyst and metastasis (3, 9.38%), etc.

In our study, the percentage of extra-axial tumors is 50.91% and the intra-axial tumors are 49.09%. The most common extra-axial (Chart 1) and (Chart 2) intra-axial tumors were acoustic schwannoma (42.86%) and metastasis (22.22%), respectively.

In our study, 12 patients had been diagnosed with Acoustic neuroma. The most common location was the right CP angle (Fig. 1). The age group affected by Schwannoma was in the 2nd to 7th decade with a male-to-female ratio of 1: 1.14.

In our study, seven patients were diagnosed with a arachnoid cyst (Fig. 2). The most common symptoms were headache and altered mental state. Arachnoid cysts were in the right, paramedian site, and left cerebellar hemisphere.

In our study, six patients had been diagnosed with metastasis (Fig. 3). The most common location was the cerebellum. In our study, two male patients had lung cancer metastases. On TIWI, all cases were hypointense; on T2WI and FLAIR, they were hyperintense. In every instance, a heterogeneous enhancement that was not limited to Diffusion-weighted image (DWI) was seen.

In our study, five patients had been diagnosed with meningioma (Fig. 4). The most common symptoms were headache and altered mental state. Four cases of meningioma showed a dural tail sign. In one case, a Tl-weighted axial image with gadolinium enhancement showed mass compressing and displacing the fourth ventricle and the cerebellum.

In our study, four patients had been diagnosed with epidermoid cysts (Fig. 5). The right CP angle was a common location in two of them and the left CP angle in others. All cases showed dirty signals on FLAIR and DWI restriction and no contrast enhancement.

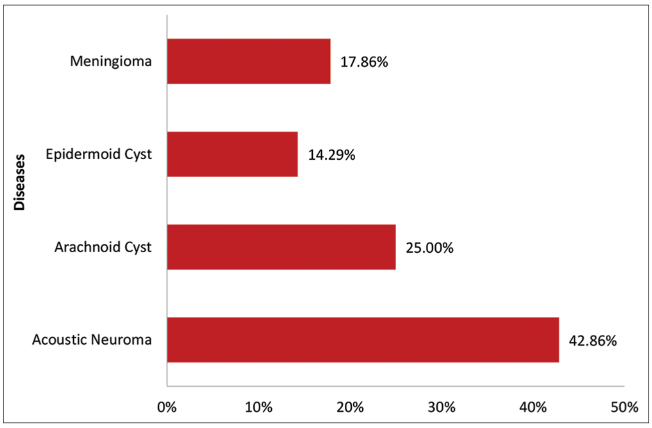


**Chart 1: Extraaxial lesions**

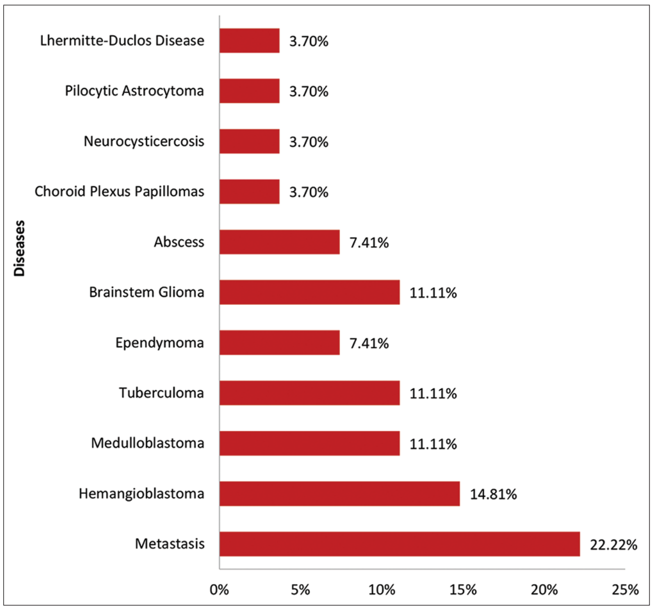


**Chart 2: Intraaxial lesions**

**Table 1: Age-wise distribution of patients**

| Age group (years) | No. of cases | | Total (%) |
|---|---|---|---|
| | Male (%) | Female (%) | |
| 18–20 | 2 (6.25) | 1 (4.35) | 3 (5.45) |
| 21–30 | 6 (18.75) | 7 (30.43) | 13 (23.64) |
| 31–40 | 5 (15.63) | 5 (21.74) | 10 (18.18) |
| 41–50 | 3 (9.38) | 3 (13.04) | 6 (10.91) |
| 51–60 | 7 (21.88) | 3 (13.04) | 10 (18.18) |
| 61–70 | 5 (15.63) | 3 (13.04) | 8 (14.55) |
| >70 | 4 (1.25) | 1 (4.35) | 5 (9.09) |
| Total | 32 (58.18) | 23 (41.82) | 55 (100) |

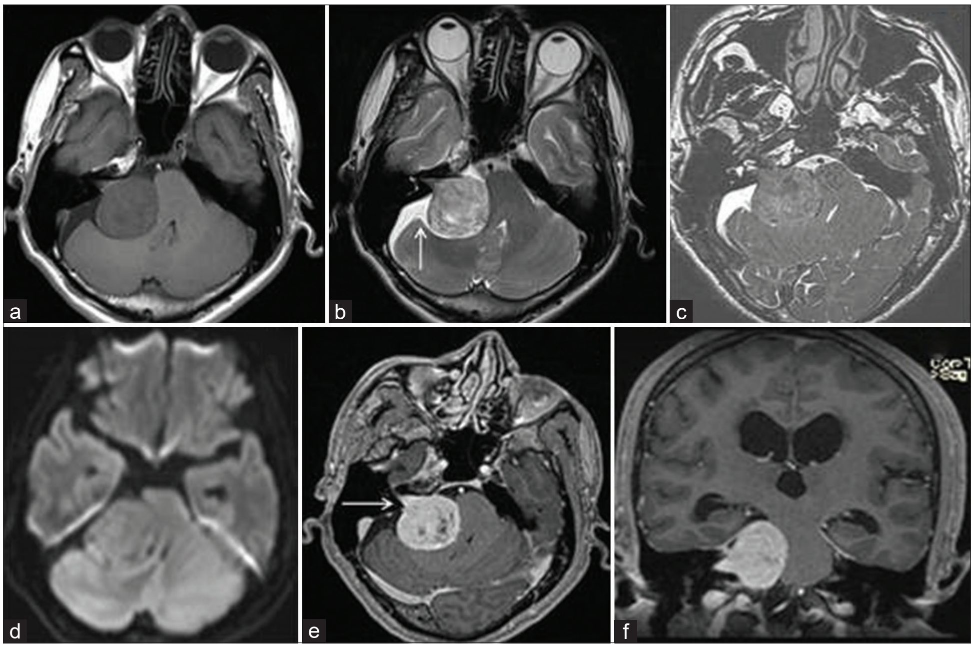


**Fig. 1: (a and b) Axial T1WI and T2WI images show an extra-axial T1W isointense and T2 mixed signal intensity extra-axial lesion in the right C-P angle cistern with cerebrospinal fluid cleft (↑arrow). (c) 3D-CISS image shows the tumoral extension into the right IAC. (d) Diffusion-weighted image image does not show diffusion restriction. (e and f) Axial and coronal T1W post-contrast images show moderate homogenous enhancement of the lesion (→arrow)**

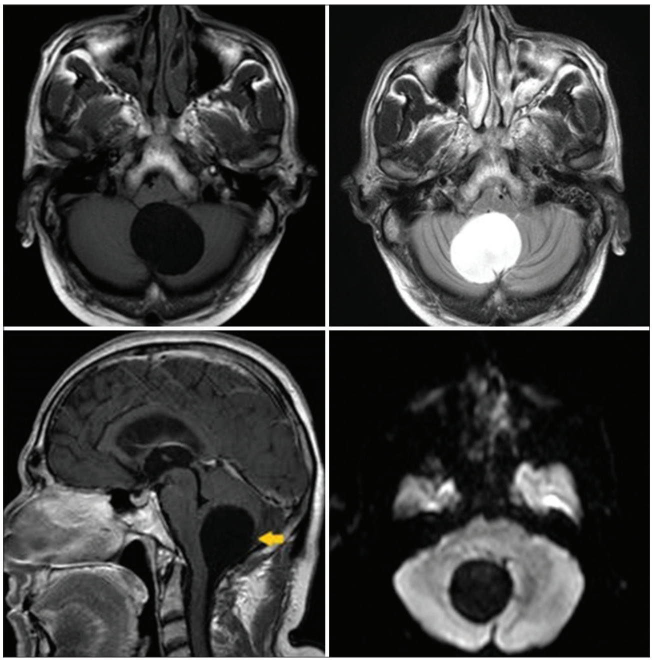

**Fig. 2: On magnetic resonance imaging a large well circumscribed midline infratentorial cystic lesion appearing hypointense on T1W and hyperintense on T2W with Fluid attenuated inversion recovery suppression, shows no restriction on Diffusion-weighted image and apparent diffusion coefficient mapping which helps to differentiate them from their close differential of an epidermoid cyst. They do not enhance after gadolinium administration**

In our study, four patients had been diagnosed with Hemangioblastoma (Fig. 6). The left cerebellar hemisphere was a common location in them and the common complaint was headache and imbalance.

In our study, three patients had been diagnosed with Tuberculoma (Fig. 7). The most common location was the cerebellum.

In our study, three patients were diagnosed with medulloblastoma. The chief complaint was headache followed by cerebellar manifestations. Out of these, 2 were located in the cerebellum and one in the vermis. Restricted diffusion within the tumor in axial diffusion-weighted image. On T1 the mass appears hypointense. DWI revealed an increased signal.

In our study, three patients had been diagnosed with brainstem glioma. The most common location was the midbrain and Pons. On MRI, they are usually hyperintense relative to gray matter on T2-weighted and FLAIR images and hypointense relative to gray matter on T1-weighted images. Most brainstem gliomas do not enhance.

In our study, two patients were diagnosed as abscesses. The most common location was the cerebellar hemisphere.

In our study, two patients had been diagnosed as ependymoma. The most common location was the fourth ventricle.

## DISCUSSION

The study was conducted on 55 patients who presented to our radiology department for MRI examination for posterior fossa space-occupying lesions.

In our study, a maximum number of patients (41.82%) were seen in 21–40 years of age followed by 18.18% in 51–60 years and 14.55% in 61–70 years of age group. There was male preponderance over females with a ratio of 1.39: 1. In Bharada *et al*. study, most of the patients were above 50 years of age (53.33% of all patients) with the largest age group between 51 and 60 years (25% of all patients).

When we analyzed according to gender, we found that the most common space-occupying lesion in female patients was acoustic neuroma (7 patients, 30.43%) followed by hemangioblastoma and metastasis (3 patients, 13.04% each). In male patients, the most common space-occupying lesion was an arachnoid cyst (6, 18.75%) followed by acoustic neuroma (5, 15.63%), meningioma (4, 12.50%), epidermoid cyst and metastasis (3, 9.38%), etc. According to Modi *et al*. glioma, schwannoma, and meningioma (3 patients, 18.8% in each tumor) were the most prevalent tumors in female patients, followed

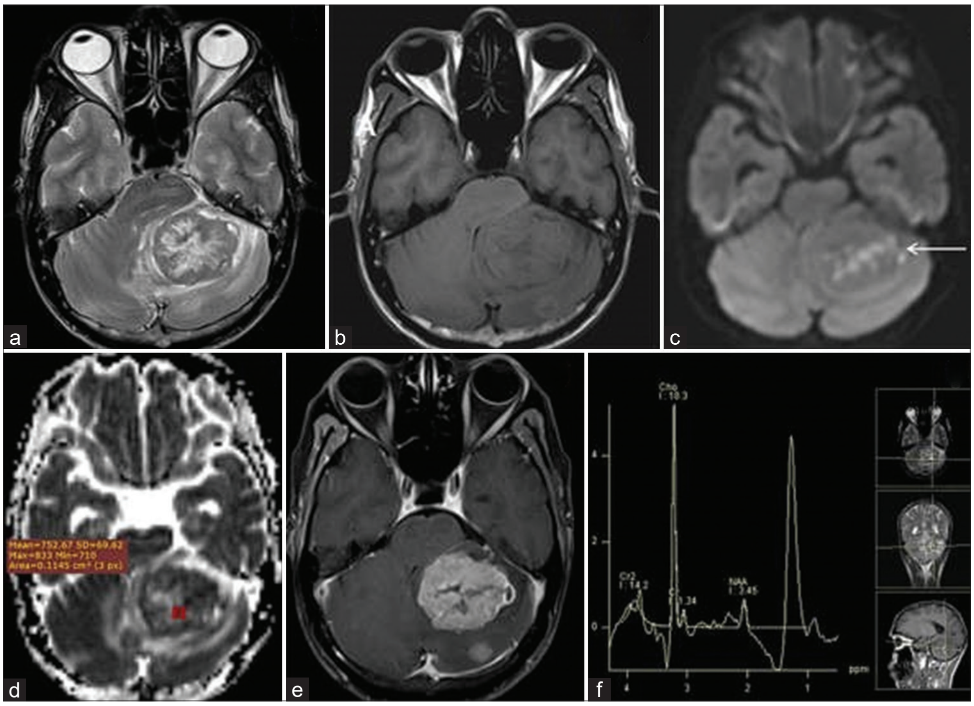


**Fig. 3: (a) Axial T2WI image shows central T2W hyperintense and peripheral isointense larger lesion in the left cerebellar hemisphere. (b) Axial T1WI image shows isointense signal intensities within the larger lesion. (c and d) Axial Diffusion-weighted images and apparent diffusion coefficient map images show patchy diffusion restriction (←arrow). (e) Axial T1W post-contrast image shows heterogeneous enhancement of the larger lesion with central necrosis. (f) Magnetic resonance spectroscopy images show increased choline and lipid-lactate peaks with reduction of NAA peak**

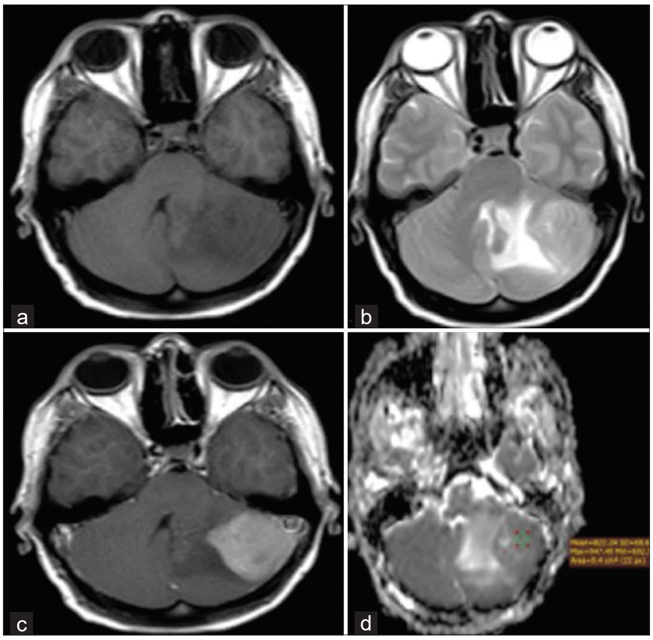


**Fig. 4: Typical cerebellar (infratentorial) meningioma is seen which displays relatively iso to low signal intensity (SI) on T1WI (a), iso SI on T2 WI (b). It shows homogeneous enhancement on post-contrast T1WI (c). It has iso SI-like brain parenchyma on apparent diffusion coefficient images (apparent diffusion coefficient) map (d)**

by medulloblastoma (2, 12.3%). Only one patient (6.3%) had an Ependymoma and an Arachnoid cyst. Male patients most frequently developed schwannoma (3, 12.5%), medulloblastoma (5, 20.8%), and epidermoid cysts (6, 25.0%), respectively. Only 2 patients (4.2%) had astrocytoma and metastasis. In our study, the most common symptom identified in patients was headache (29.09%) followed by vomiting (16.36%), fever and seizures (10.91%), ataxia (9.09%), generalized weakness, hearing loss, tinnitus, visual disturbances and imbalance in 5.45% each. Priya *et al.* (2017) conducted a retrospective analysis of 75 biopsy specimens from posterior fossa lesions over a 3-year period and found that the most frequent clinical presentations were headache (67%) and vomiting (55%). Cerebellar signs (28%) and papilloedema (12%) were noted in pilocytic astrocytoma, medulloblastoma, and hemangioblastoma; [5].

In our study, the most common space-occupying lesion was acoustic neuroma (12, 2l.82%) followed by arachnoid cyst (7, 12.73%), metastasis (6, 10.91%), meningioma (5, 9.09%), hemangioblastoma and epidermoid cyst (4, 7.27%), medulloblastoma, brainstem glioma and tuberculoma in 3 (5.45%) and abscess, and ependymoma in 2 (3.64%) each. In a study conducted by Saini Sunita *et al.*, it was found that schwannoma was the most common benign tumor, 102 (36.42%). Although schwannoma occurs in all age groups but is more common in adults, 96/102 cases were present in adults, only six cases of schwannoma were found in pediatric age groups followed by medulloblastoma (37/280) and then pilocytic astrocytoma was seen in 31/280 cases [6].

In our study, 12 patients had been diagnosed with acoustic neuroma. The most common location was the right CP angle. The age group affected by schwannoma was in the 2nd to 7th decade with a male-to-female ratio of 1: 1.14. This is comparable to the findings of Casadei *et al.*, which showed peak incidence in the 4th to 6th decade and a male-to-female ratio of 1: 2. Tinnitus, hearing loss, and cranial nerve palsies were the most frequent symptoms [7].

In our study, four cases of meningioma showed a dural tail sign. In one case, a Tl-weighted axial image with fadolinium enhancement showed mass compressing and displacing the fourth ventricle and the cerebellum. A dural tail sign is seen in meningioma as noted by Kalyani *et al.* [8].

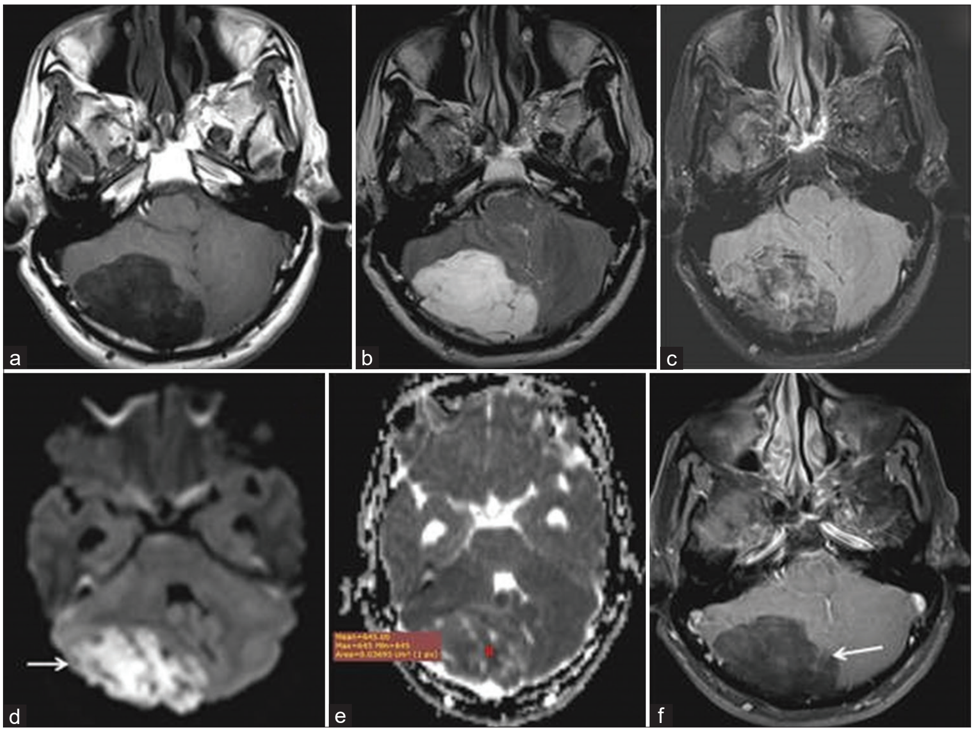


**Fig. 5: (a and b) Axial T1WI and T2WI images show an extra-axial heterogeneous appearing T1WI hypointense and T2WI hyperintense lesion over the right cerebellar convexity. (c) Fluid attenuated inversion recovery image shows incomplete suppression of the cyst. (d and e) Axial Diffusion-weighted image and apparent diffusion coefficient (ADC) map images show restricted diffusion (→arrow) with variable ADC values. (f) Axial T1W post-contrast image shows no enhancement (←arrow)**

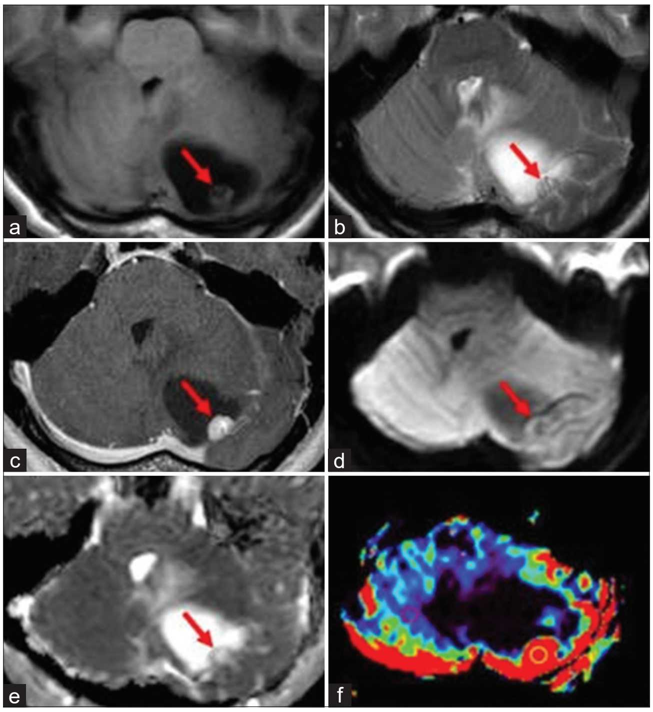


**Fig. 6: (a) Axial T1-weighted image (T1WI) showing a cystic mass lesion with a mural nodule in the left cerebellar hemisphere. (b) Axial T2WI showing flow voids (arrow) in the mural nodule. (c) Axial contrast-enhanced T1WI showing homogeneous enhancement of the mural nodule (arrow) and no enhancement of the cyst wall. (d) Axial diffusion-weighted image showing that the mural nodule (arrow) is low-intense. (e) A corresponding apparent diffusion coefficient (ADC) map showing increased ADC of the nodule (arrow). (f)PWI showing same cystic mass with mural nodule in red**

In our study, seven patients were diagnosed with a arachnoid cyst. Arachnoid cysts were located in the posterior cranial fossa in the right, paramedian site, and left cerebellar hemisphere. In a study by Galarza *et al*., the posterior fossa arachnoid cysts were located at the vermis-cisterna magna (n=4), the cerebellar hemispheres (n=2), the cerebellopontine angle (CPA) (n=3), and the quadrigeminal cistern (n=1) [9].

Generally, on Tl, medulloblastoma is hypointense to grey matter. More than 90% mass shows enhancement on T1 contrast with gadolinium. In T2/FLAIR mass is iso to hyperintense to grey matter. In DWI/apparent diffusion coefficient, it shows restricted diffusion. These features could be considered in the evaluation of the high-risk medulloblastoma subtype by Yeom *et al*. [10].

Radiologically. epidermoid is seen as extra-axial lesions in the basal cisterns. On Tl-weighted images, it appears hypointense to the gray matter and hyperintense to cerebrospinal fluid (CSF). On T2-weighted images, it is hyperintense to gray matter and to CSF. Diffusion-weighted images show restricted diffusion. CSF and arachnoid cysts appear hypointense. In our study, it was found in four patients (three male and one female). All cases showed dirty signals on FLAIR and DWI restriction and no contrast enhancement in one case, a heterogenous low-signal intensity tumor with no enhancement was observed in the Tl-weighted image. The T2-weighted image showed an inhomogeneous high-intensity lesion. These findings were consistent with the study conducted by Bhat *et al*. [11].

In our study, six patients had been diagnosed with metastasis. According to a study by Fink and Fink the MRI features of metastases may point to a pathologic diagnosis at the root of the problem. Hemorrhagic metastases can be seen in thyroid cancer, melanoma, renal cell carcinoma, and choriocarcinoma. However, due to higher prevalence, breast and lung cancers have the most metastases overall. In our study, two male patients had lung cancer metastases. On TIWI, all cases were hypointense; on T2WI and FLAIR, they were hyperintense. In every

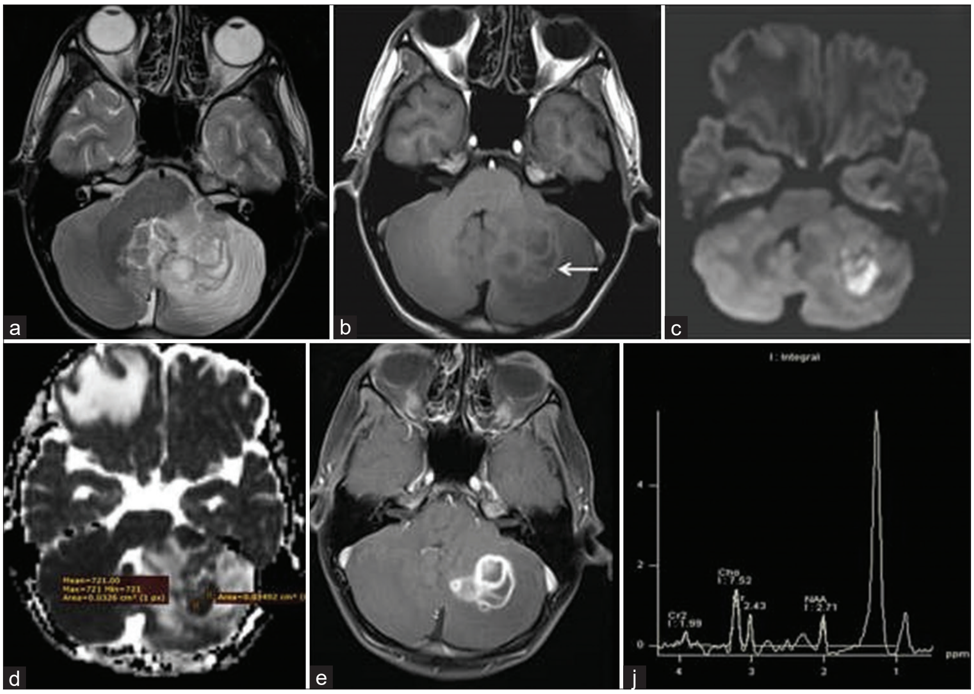


**Fig. 7: (a and b) Axial T2WI and T1WI images show conglomerated central T2W hyperintense and peripheral hypointense lesions in the left cerebellar hemisphere. T1WI shows peripheral T1WI hyperintensities within the lesions (←arrow). (c and d) Axial Diffusion-weighted images and apparent diffusion coefficient (ADC) map images show central restricted diffusion with low ADC values. (e) Axial T1W post-contrast image show thick-walled peripherally enhancing conglomerated lesions. (f) Magnetic resonance spectroscopy image shows a large lipid peak at 0.9–1.3 ppm and a reduction of NAA peak**

instance, a heterogeneous enhancement that was not limited to DWI was seen [12].

In our study, two patients had been diagnosed with Ependymoma. The oldest patient was 35 years female and the youngest was 26 years male. The most common location was the 4th ventricle, so the site of the lesion was the 4th ventricle in all the cases (100%) compared to 60% in the series of Schiffer *et al*. [13].

Cerebellar hemisphere (53%) and vermis (16%) were the most frequent sites of pilocytic astrocytoma in the Yildiz *et al*. study, with 26% in each. It was observed in one case in our study, 36-year-old female diagnosed with pilocytic astrocytoma involving the left cerebellum and vermis [14].

There were almost equal numbers of intra- and extra-axial cases. In our study, the percentage of extra-axial tumors is 50.91% and the intra-axial tumors are 49.09%. The most common extra- and intra-axial tumors were acoustic schwannoma (42.86%) and metastasis (22.22%), respectively. Similar results were seen in a study conducted by Tamilchelvan *et al*. where posterior fossa metastasis was the most common intra-axial lesion in the posterior fossa while vestibular schwannoma was the most common extra-axial space-occupying lesion [15].

## CONCLUSION

Headache and vomiting were the most common symptoms of a CPA space-occupying lesion, but they can also be accidental findings.

Due to the restricted space, involvement of the crucial brain stem nuclei, and involvement of the fourth ventricle, posterior fossa space-occupying lesions are regarded as critical brain lesions. Risks in this area include compression of the brain stem, herniation, hydrocephalus, and death. Early diagnosis and treatment are now possible thanks to modern diagnostic and therapeutic modalities, and as a result, the mortality rate has been significantly decreased.

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## CONFLICTS OF INTEREST

There are no conflicts of interest.

## FINANCIAL SUPPORT AND SPONSORSHIP

Nil.

## REFERENCES

1. Gollapalli SL, Moula MC, Shriram K, Durga K. Spectrum of posterior cranial fossa space occupying lesions-our experience at a tertiary care centre. J Evol Med Dent Sci. 2018 Sep 3;7(36):4022-6.
2. Meenakshisundaram N, Dhandapani B, Meenakshisundaram N, Dhandapani B. Posterior cranial fossa space occupying lesions: An institutional experience. Int J Res Med Sci. 2018 Jul;6(7):2281-4. doi: 10.18203/2320-6012.ijrms20182429
3. Patil PV, Patel R, Dixit R, Singh S, Chowdhury V. MRI of the Posterior Cranial Fossa: Spectrum of Abnormalities in Pediatric Patients. In: European Congress of Radiology-ECR; 2014. doi: 10.1594/ecr2014/C-1069
4. Hari PS, Jyothi JA, Thatipamula M. Study of posterior fossa tumors by high resolution MRI. J Evid Based Med Healthc. 2016;3(6):197-203. doi: 10.18410/jebmh/2016/46
5. Priya VS, Kurien SS, Kurien S. Posterior cranial fossa lesions--a clinicopathological correlative study. J Evol Med Dent Sci. 2017 Aug 10;6(64):4666-9. doi: 10.14260/Jemds/2017/1009
6. Yuh EL, Barkovich AJ, Gupta N. Imaging of ependymomas: MRI and CT. Childs Nerv Syst. 2009 Oct;25(10):1203-13. doi: 10.1007/s00381-009-0878-7, PMid: 19360419
7. Casadei GP, Komori T, Scheithauer BW, Miller GM, Parisi JE, Kelly PJ. Intracranial parenchymal schwannoma: A clinicopathological and neuroimaging study of nine cases. J Neurol Surg. 1993 Aug 1;79(2):217-

22. doi: 10.3171/jns.1993.79.2.0217, PMid: 8331403

8. Kalyani D, Rajyalakshmi S, Kumar OS. Clinicopathological study of posterior fossa intracranial lesions. J Med Allied Sci. 2014Jul 31;4:62-8.
9. Galarza M, López-Guerrero AL, Martínez-Lage JF. Posterior fossa arachnoid cysts and cerebellar tonsillar descent: Short review. Neurosurg Rev. 2010 Jul;33(3):305-14. doi: 10.1007/s10143-010-0262-9, PMid: 20480382
10. Yeom KW, Mobley BC, Lober RM, Andre JB, Partap S, Vogel H, *et al*. Distinctive MRI features of pediatric medulloblastoma subtypes. AJR Am J Roentgenol. 2013Apr;200(4):895-903. doi: 10.2214/AJR.12.92491, PMid: 23521467
11. Bhat DI, Devi BI, Raghunath A, Somanna S, Chandramouli BA. Interhemispheric epidermoids-an uncommon lesion in an uncommon location: A report of 15 cases. Neurol India. 2011 Jan 1;59(1):82-6. doi: 10.4103/0028-3886.76874, PMid: 21339669
12. Fink KR, Fink JR. Imaging of brain metastases. Surg Neurol Int. 2013;4(Suppl 4):S209-19. doi: 10.4103/2152-7806.111298, PMid: 23717792
13. Schiffer B, Peschel T, Paul T, Gizewski E, Forsting M, Leygraf N, *et al*. Structural brain abnormalities in the frontostriatal system and cerebellum in pedophilia. J Psychiatr Res. 2007 Nov 1;41(9):753-62. doi: 10.1016/j.jpsychires.2006.06.003, PMid: 16876824
14. Yildiz H, Erdogan C, Yalcin R, Yazici Z, Hakyemez B, Parlak M, *et al*. Evaluation of communication between intracranial arachnoid cysts and cisterns with phase-contrast cine MR imaging. AJNR Am J Neuroradiol. 2005 Jan 1;26(1):145-51. PMid: 15661716
15. Tamilchelvan P, Boruah DK, Gogoi BB, Gogoi R, Tamilchelvan P, Gogoi B. Role of MRI in differentiating various posterior cranial fossa space-occupying lesions using sensitivity and specificity: A prospective study. Cureus. 2021 Jul 12;13(7):e16336. doi: 10.7759/cureus.16336, PMid: 34395119