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Evaluation Of Common Posterior Fossa Lesions In Pediatric Age Group On Magnetic Resonance Imaging.

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Abstract

Brain tumors are most common solid neoplasms in children and second most common paediatric malignancy following leukemia. Approximately 65% of all brain pediatric tumors arise in the Posterior fossa. The present study is aimed to assess the MRI features of common posterior fossa brain tumours in children including medulloblastomas, ependymomas and pilocytic astrocytomas along with the postoperative parameters to contribute to the knowledge to the neuroradiology and neurosurgery fields. In this study carried out from February 2022 to July 2023, all pediatric patients with posterior fossa tumors opted for MRI at Pravara Institute of medical sciences, Loni, were evaluated, their characteristics and MRI findings are studied. There were 20 patients (10 medulloblastomas, 4 ependymomas, and 6 pilocytic astrocytomas) in this research. Medulloblastomas and ependymomas showed diffusion restriction on DW images with corresponding drop in ADC whereas pilocytic astrocytomas usually show no diffusion restriction. MRI is a very important tool for determining characteristics of medulloblastomas, ependymomas, and pilocytic astrocytomas in the posterior fossa. Advanced brain MRI techniques provide incremental diagnostic value over conventional MRI. No single advanced technique is perfect but different techniques complement one another.

Keywords: Posterior fossa lesions, pediatric age group, Magnetic Resonance Imaging.

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INTRODUCTION

Brain tumours account for about 20 to 25% of all malignancies in children under the age of 15 and 10% of brain tumours develop in children aged 15 to 19 [1]. Brain tumours can be primary (originating in the brain) or secondary (arising from another primary location of malignancy). Secondary metastases account for more than 25% of all brain tumours. Primary brain tumours are the second most common type of cancer in children under the age of 15 years [2]. Benign brain tumors such as meningioma and acousticneuroma form a major part of primary brain tumors [3]. Approximately 65% of all brain pediatric tumors arise in the posterior fossa. The commonest tumors are pilocytic astrocytoma (commonest), medulloblastoma (MB), ependymoma, brainstem glioma, atypical teratoid rhabdoid tumor, hemangioblastoma (uncommon except with Von Hippel-Lindau syndrome (VHL)), and teratoma (ininfant) [4].

Diagnosis of brain tumors by conventional magnetic resonance imaging (MRI) is based on non-contrast T1-weighted images (T1WI) and T2-weighted images (T2WI) and post-contrast (T1WI). Conventional MRI techniques are considered not enough for grading, classifying, and detecting the aggressiveness of brain tumors [5].

Symptoms of brain tumors include persistent headache, vomiting, visual disturbance, hearing or speech difficulties, walking problems, personality changes, memory problems, seizures, and loss of weight. While symptoms and signs of posterior fossa tumors in children are the same as those in adults, characteristic headache that worsen at night and early morning and in recumbency that improves with vomiting in addition to behavioral and mental changes, lethargy, irritability, and decreased appetite was also noted. Note that chronic torticollis should be considered as an alarm for the possibility of the presenceof a posterior fossa mass.

Although conventional MRI is an important tool for diagnosis and evaluation of the location, quality, and extent of posterior fossa tumours, as well as for follow-up, it provides limited information about grade and type [6]. Diffusion weighted imaging (DWI) and apparent diffusion coefficient (ADC) maps improve MRI sensitivity and specificity, offer information about tumour cellularity and play an essential role in preoperative tumour distinction. ADC value is a simple and available technique for the evaluation of pediatric cerebellar neoplasm and accurately differentiates between the most common tumor types. ADC value is irreversibly proportionate to the tumor cellularity (primary brain tumor with higher cellularity or higher grade have lower ADC value) [7, 8].

MATERIAL AND METHOD

The study was carried out in the Department of Radiology and Department of Neurosurgery, from February2022 to July 2023. In this research, all pediatric patients adopted MRI to evaluate the tumours' characteristics before treatment. Then, patients underwent surgery to eradicate the posterior fossa tumours.

All MRI images were interpreted by two radiologists. It is noted that MRI protocols were the same and fully approved by both radiology and neurosurgery departments including non-contrast sagittal T1-weighted imaging (T1W); axial T2-weighted imaging (T2W), coronal T2-Fluid-Attenuated Inversion Recovery (FLAIR), axial gradient-recalled echo T2*WI, axial Diffusion-weighted imaging (DWI) with apparent diffusion coefficient (ADC) and axial T1-weighted with contrast enhancement (CE) (T1CE).

Baseline parameters included the age, sex, symptoms, tumour location, tumour characteristics (main structure, components, dilated ventricle, peritumoral oedema, and tumour extension). MRI parameters were comprised of signal intensity (SI) of T1W, T2W, FLAIR, DWI, ADC, and T1CE.

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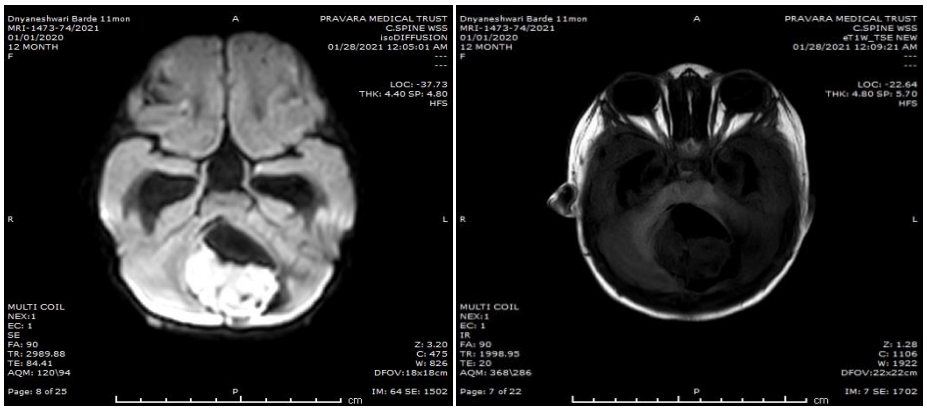
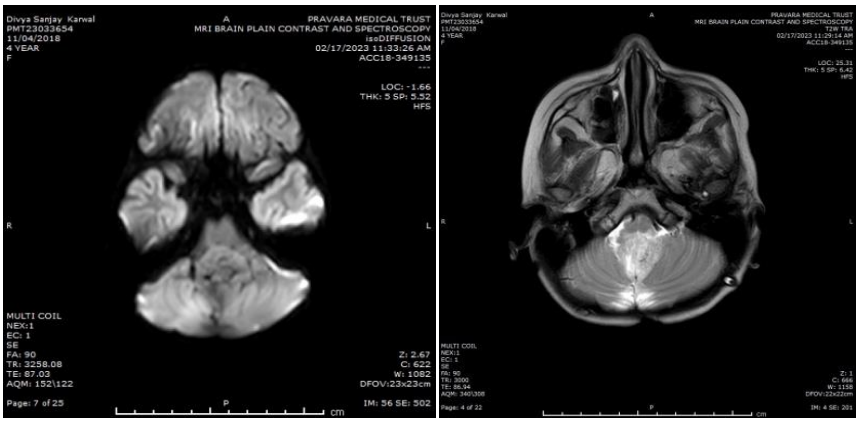
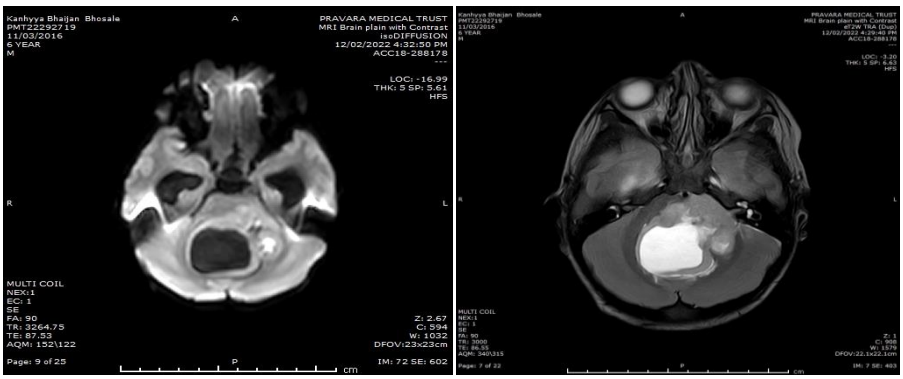
Case 1: Medulloblastoma



Case 2: Ependymoma



Case 3: Pilocytic Astrocytoma



Statistical analysis

The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using IBM SPSS (SPSS Inc., IBM Corporation, NY, USA) Statistics Version 25 for Windows software program. Descriptive statistics included computation of percentages, means and standard deviations. The data were checked for normality before statistical analysis using Kolmogorov Simonov test. The ANOVA test (for quantitative data to compare two and more than two observations) was applied. The chi square test was used for qualitative data comparison of all clinical indicators. Level of significance was set at $P \leq 0.05$.

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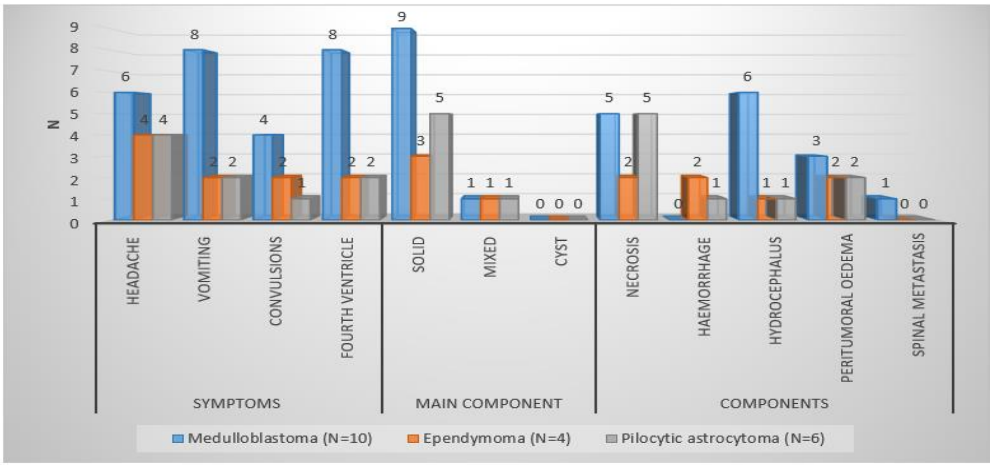
RESULTS

Table 1: Baseline characteristics

	Medulloblastoma (N=10)	Ependymoma (N=4)	Pilocyticastrocytoma (N=6)	P value
Age (mean ± SD)	6.56±1.17	5.69±1.17	7.19±1.38	0.001 (S)
Gender (M/F)	6 / 4	2/ 2	1/ 3	0.01 (S)
Symptoms N (%)				0.53
Headache	6 (60)	4 (100)	4 (66.6)	
Vomiting	8 (80)	2 (50)	2 (33.3)	
Convulsions	4 (40)	2 (50)	1 (16.7)	
Fourth ventricle	8 (80)	2 (50)	2 (33.3)	
Main component N (%)				0.001 (S)
Solid	9 (90)	3 (75)	5 (83.3)	
Mixed	1 (10)	1 (25)	1 (16.7)	
Cyst	0	0	0	
Components N (%)				0.001 (S)
Necrosis	5 (50)	2 (50)	5 (83.3)	
Haemorrhage	0	2 (50)	1 (16.7)	
Hydrocephalus	6 (60)	1 (25)	1 (16.7)	
Peritumoral oedema	3 (30)	2 (50)	2 (33.3)	0.205
Spinal Metastasis	1 (10)	0	0	0.001 (S)



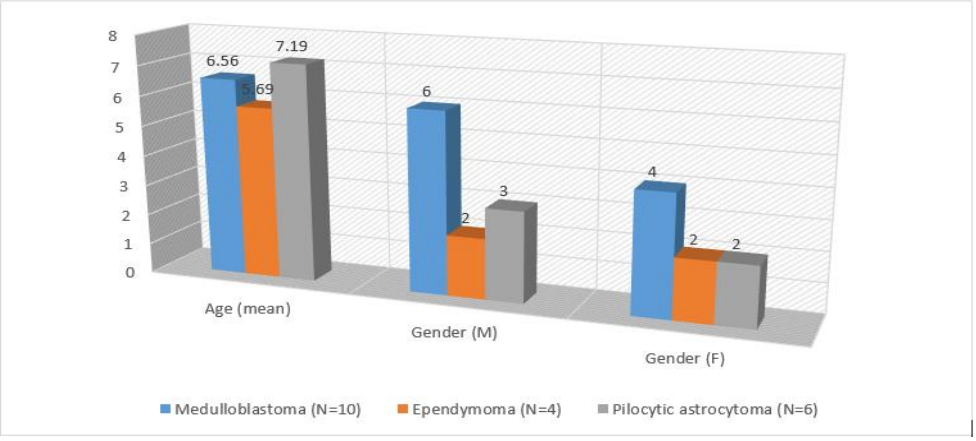


Table 2: MRI characteristics

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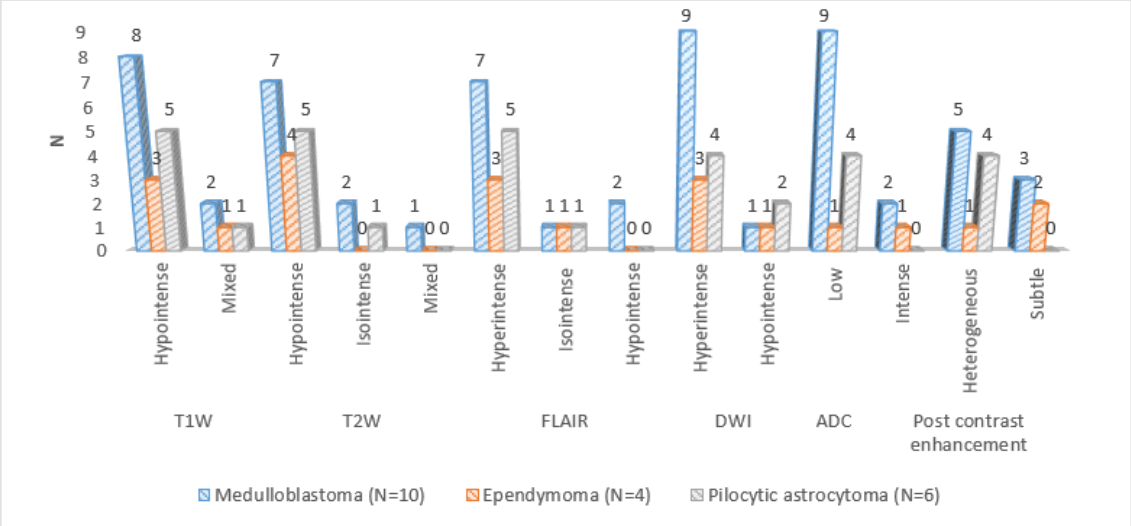
N (%)	Medulloblastoma (N=10)	Ependymoma (N=4)	Pilocyticastrocytoma (N=6)	P value
T1W				0.76
Hypointense	8 (80)	3 (75)	5 (83.3)	
Mixed	2 (20)	1 (25)	1 (16.7)	
T2W				0.001 (S)
Hyperintense	7 (70)	4 (100)	5 (83.3)	
Isointense	2 (20)	0	1 (16.7)	
Mixed	1 (10)	0	0	
FLAIR				0.001 (S)
Hyperintense	7 (70)	3 (75)	5 (83.3)	
Isointense	1 (10)	1 (25)	1 (16.7)	
Hypointense	2 (20)	0	0	
DWI				0.001 (S)
Hyperintense	9 (90)	3 (75)	4 (66.6)	
Hypointense	1 (10)	1 (25)	2 (33.3)	
ADC				0.001 (S)
Low	9 (90)	1 (25)	4 (66.6)	
Post contrast enhancement				0.001 (S)
Intense	2 (20)	1 (25)	0	
Heterogeneous	5 (50)	1 (25)	4 (66.6)	
Subtle	3 (30)	2 (50)	0	



DISCUSSION

In this clinical study, we focused only the three most common posterior fossa brain tumours including medulloblastomas, ependymomas, and pilocytic astrocytomas. In our study, mean ages for medulloblastomas, ependymomas, and pilocytic astrocytomas were 6.56; 5.69; and 7.19. The male to female ratios for medulloblastomas, ependymomas, and pilocytic astrocytomas in this present study were 6/4; 2/2 and 1/3. We observed that there were significant differences between age and gender among these groups. In a previous study, mean ages of medulloblastomas, ependymomas, and pilocytic astrocytomas were 6.2; 4.7; and 6.2, respectively. Moreover, the male to female ratios for medulloblastomas, ependymomas, and pilocytic astrocytomas were 1.3/1; 0.67/1; and 1.12/1 [9]. According to many research papers, medulloblastomas, which account for 40% of posterior fossa tumours and are more common in males, are usually seen before the age of seven, whereas ependymomas, which account for approximately 20% of posterior fossa tumours in children with a slight

increase in incidence in boys, have a peak incidence in younger paediatric patients between the ages of three and five [10, 11]. On the other hand, pilocytic astrocytomas, making up 30% of posterior fossa tumours, appearing between the ages of 5 to 13 year old, have an equal incidence between girls and boys. Although there are minor differences in mean ages and gender ratios amongst research, the findings of our analysis are consistent with epidemiological data [12-15].

Medulloblastomas and Pilocyticastrocytoma, usually predominantly solid tumours. Medulloblastomas usually move from the vermis to the fourth ventricle, whereas ependymomas primarily grow in the fourth ventricle, both resulting in ventricular blockage and hydrocephalus. Medulloblastomas may hardly expand into the foramina of Magendie or Luschka whereas ependymomas frequently show extension through Magendie and Luschka foramina. Pilocytic astrocytomas, on the other hand, are invariably located in the cerebellar hemisphere and have a mixed appearance of the cystic tumour and the mural section. They develop slowly and rarely become solid tumours [11, 16].

Typically, medulloblastomas are densely packed cells and hyperchromatic nuclei, which will result in hypo intensity to isointense on T1W image. Both hyperintensity on DWI and hypo intensity on ADC coexisting with hypointense to isointense T2W are due to high cellularity of the tumour [17]. Meanwhile, ependymomas are characterised by hypointense T1W, hyperintense T2W, and iso- to hyperintense FLAIR. Tumours often show ardent enhancement on post-contrast enhancement T1W images. Despite being composed of solid tissue, few tumours exhibit little or no post-gadolinium enhancement. DWI reveals decreased diffusivity within most ependymomas due to excessive cellularity. It has been found that ependymoma diffusivity is typically intermediate between that of medulloblastomas and pilocytic astrocytomas [18]. Pilocytic astrocytomas often present as a cystic tumour with a mural nodule. Pilocytic astrocytoma cysts are often hypointense on T1W and hyperintense on T2W and FLAIR. When the fluid is extremely proteinaceous, tumours show hyperintensity on T1W and FLAIR in a few cases. Pilocytic astrocytomas are characterised by unrestricted diffusion [19, 20]. Tumours primarily exhibit heterogeneous enhancement due to core cysts that do not absorb contrast agents, whereas mural sections tend to increase uniformly and visibly [10]. As shown in Table 2, our MRI findings are completely in line with above studies

CONCLUSION

In conclusion, MRI is critical in demonstrating the characteristics of these cancers for accurate diagnosis and therapy planning. In practise, each tumour has typical MRI findings that enable clinicians discriminate based on baseline and MRI characteristics. Medulloblastomas are problematic brain tumours that clinicians should evaluate in cases of bigger feet-to-head diameter of cancer to ensure the efficacy and safety of surgery for patients.

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