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ROLE OF MRI IN COMMON POSTERIOR FOSSA TUMORS

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ABSTRACT: MR imaging plays an increasingly important role in evaluation of patients suspected of harbouring disease in the posterior fossa because of its superior virtually artefact free display of anatomy and pathology in this region. The combination of clinical presentation and MR imaging results permit prediction of the histology of a posterior fossa tumor. In this article, we review the most common posterior fossa tumours and also advanced imaging methods, such as MR spectroscopy, perfusion MRI, and tractography, which helps to develop a more accurate diagnosis and aid in planning tumor treatment.

KEYWORDS: MRS, pMR, TIWI, T2WI, and Tractography.

INTRODUCTION: Tumors in the posterior fossa are considered some of the most critical brain lesions. This is due primarily to the limited space within the posterior fossa, as well as the potential involvement of the vital brain stem nuclei. Computed tomography (CT) of the posterior fossa and brain stem is limited by bone. Magnetic resonance (MR) imaging has played an increasingly important role in evaluation of patients suspected of harboring disease in the posterior fossa.^[1,2] It has multiplanar capability and higher spatial and contrast resolution. Gadolinium enhancement is often helpful to identify and characterize lesions. Sagittal imaging in particular is critical for evaluation of lesions that spread to and through the foramen magnum. Accurate size estimation and lesion location are crucial for surgical planning. The histologic picture can often be predicted with a high degree of accuracy if the age of the patient, the exact tumour location and the imaging characteristics are taken into consideration. Tractography allows visualization of spatial relations between tumor and adjacent fiber tracts.^[3]

- 1. Pediatric tumors:** Cerebellar astrocytomas are the most common posterior fossa tumor in children.^[4] Medulloblastoma (PNET) is the second most common posterior fossa tumor in children accounting for 25% of all intracranial tumors in this age group.^[5] Ependymomas account for about 10% of all pediatric brain tumors and are the third most common fourth ventricular neoplasm in children.^[6] The fourth most common posterior fossa mass in children is brainstem glioma.^[4]
- 2. Adult tumors:** The three most common primary posterior fossa neoplasms in adults are all extra axial: Schwannoma, meningioma and epidermoid tumors.^[5]

DISCUSSION:

- 1. Cerebellar astrocytoma:** WHO grade I tumor. Majority of the cerebellar astrocytomas are of the pilocytic variety and are pathologically similar to the diencephalic or hemispheric

REVIEW ARTICLE

pilocytic found in the supratentorial region. These lesions are seen with higher frequency in patients with neurofibromatosis.

MRI FEATURES: A midline or hemispheric mass, comprised of a single large cyst with a nodular solid portion often located in the wall of the cyst. The solid portion of the tumor is iso- to hypointense on T1WI and iso- to hyperintense on T2WI whereas the cystic portion is slightly hyperintense to CSF, on both T1- and T2WI. The solid portion of the tumour enhances densely with IV contrast, while the cyst wall may or may not enhance (Fig.1.). MRS shows elevated Cho, low NAA and a lactate peak. pMR-shows low rCBV.^[3] (Fig.2.)

Fig. 1: T1WI post contrast image shows cystic mass with solid enhancing mural nodule typical of astrocytoma.

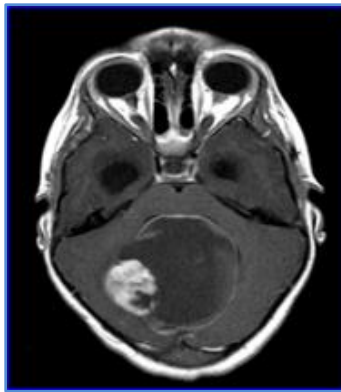


Fig. 1

Fig. 2: pMR image showing low rCBV.

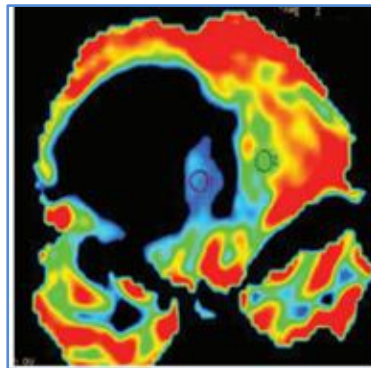


Fig. 2

2. Classic medulloblastoma (PNET-MB): This is a primitive neuroectodermal tumor that arises in cerebellum. Most occur before age of 10 years. It can be associated with other tumors as well as syndromes (e.g. basal cell nevus syndrome, Turcot syndrome, ataxia

REVIEW ARTICLE

telangiectasia). It is the most likely CNS tumor to metastasize outside the nervous system most commonly to bone and sometimes lymphnodes.

MRI FEATURES: These are heterogeneously hypointense to grey matter on T1WI, hyperintense on T2WI and often restricts on DWI.^[7] Obstructive hydrocephalus with transependymal CSF migration is common. These lesions can enhance densely after IV contrast, but commonly there is patchy irregular enhancement, perhaps due to a paucity of interstitial space.(Fig.3.) Regions of heterogeneity may be seen within, including hemorrhage, cysts or necrosis.

Fig. 3: T2WI sagittal MR images show a large, solid, and contrast-enhancing tumor dorsal to the fourth ventricle; an ill-defined dorsal tumor border with some edema within the vermis; and T2 hypointense with high cellularity is classical for medulloblastoma.

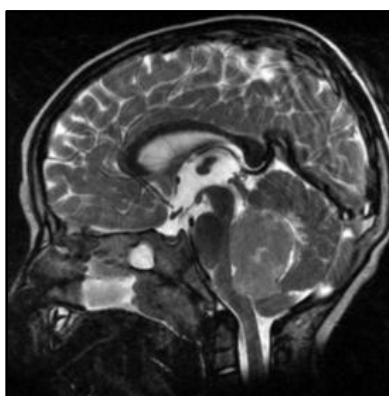


Fig. 3

3. Ependymomas: This is considered as WHO grade II neoplasm. This is a slow growing tumor. Mean age at presentation is between four and six years. There is moderate male predominance.

MRI FEATURES: Ependymomas are generally heterogeneously hypointense relative to brain parenchyma on T1WI and hyperintense on T2WI/FLAIR. Following contrast administration, most ependymomas enhance. Areas of strong, relatively homogeneous enhancement are intermixed with foci of minimal or no enhancement.^[7] (Fig.4.) Ependymomas have the highest frequency of calcification of all posterior fossa tumours, so marked hypointensity due to calcification within these masses on gradient echo MR images would support the diagnosis over medulloblastoma.

Ependymomas have a tendency to extend through the foramina of Luschka, Magendie and then downward through foramen magnum resulting in caudal tongue like projections of tumor which compress dorsal and lateral aspects of the upper cervical cord. This has been termed the 'Plastic ependymoma' by Courville and Broussalian ^[3] and although occurs in 10% of cases is highly suggestive of the diagnosis. MRS: Elevated choline and reduced NAA. pMR-markedly elevated cerebral blood volume (CBV).^[3]

REVIEW ARTICLE

Fig. 4: Axial T1 C+ MR shows lobular enhancing mass extending out 4th ventricle through foramen of Luschka into left cerebellopontine angle, classic cellular ependymoma.

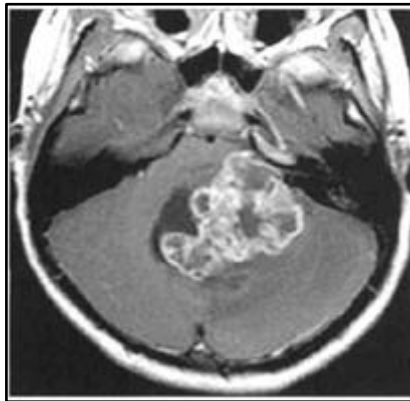


Fig. 4

4. Brainstem glioma: These tumours can be divided into 2 groups: the classic diffuse pontine glioma (WHO grade II tumors) and focal gliomas frequently pilocytic astrocytoma (WHO grade I tumors).

MRI FEATURES: These tumours appear as poorly defined regions of high signal intensity on T2WI.(Fig.5.)An undulating ventral border of the brainstem on the sagittal image may be the initial clue to the presence of a mass lesion, and when present significantly limits the differential diagnosis. Contrast enhancement has been reported in approximately one half of cases and is often focal and nodular.^[7] MRS: reduced NAA-to-choline, creatine-to-choline, and myoinositol- to-choline ratios, higher concentrations of citrate(Fig.6.). pMR-increased rCBV.^[3]

Fig. 5: MR image showing brain stem glioma.

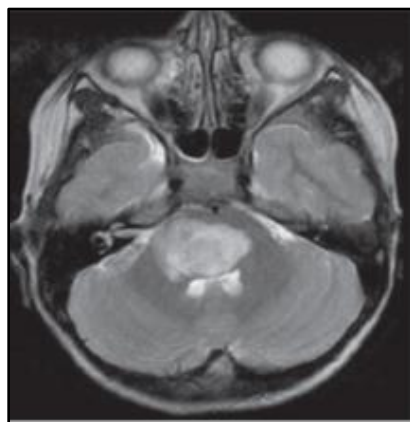


Fig. 5

REVIEW ARTICLE

Fig. 6: MRS shows a markedly increased choline peak, indicating high cell-membrane turnover.

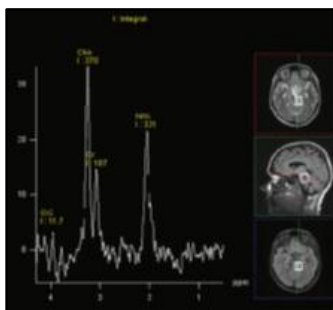


Fig. 6

5. Acoustic schwannoma: Schwannoma arises at the glial-Schwann cell junction of III-XII nerves. These are slow growing encapsulated tumors. These are seen in association with Neurofibromatosis-type 2 in which they are typically bilateral.(Fig.7.) Schwannomatosis is a condition with multiple peripheral, often painful schwannomas without other features of Neurofibromatosis-type 2. Schwannomas correspond to WHO grade I. All ages are affected, but peak incidence is in the fourth to sixth decades.

MRI FEATURES: Schwannomas are hypointense to brain on T1WI and heterogeneously hyperintense on FLAIR and T2WI. Cystic degeneration is seen as areas of hyperintensity similar to that of adjacent CSF. Contrast enhancement of the tumor is intense.^[7]

Fig. 7: MR T1WI image showing bilateral vestibular schwannomas.

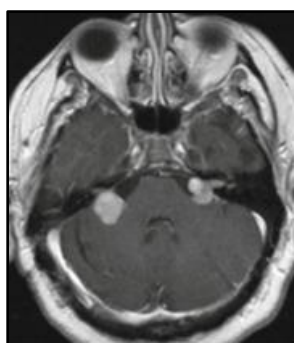


Fig. 7

6. Meningioma: Meningiomas arise from arachnoid meningotheelial cells. Peak occurrence is in the sixth and seventh decades. The WHO divides meningiomas into three groups: WHO grade I –benign meningiomas having low risk of recurrence and aggressive growth. WHO grade II- A typical meningioma and WHO grade III – malignant meningioma. Multiple meningiomas are associated with Neurofibromatosis type-2 as well as in multiple meningiomatosis syndrome.

REVIEW ARTICLE

MRI FEATURES: Most meningiomas are isointense with cortex on all sequences. Most meningiomas do not restrict on DWI. A dural tail sign (thickening of adjacent dura) is seen in majority of meningiomas. The CSF vascular cleft is well delineated on T2WI and is seen as a hyperintense rim interposed between tumor and brain. A number of flow voids representing displaced vessels are often seen within the cleft. Over 95% enhance strongly and homogeneously on contrast administration^[7] (Fig.8.) MRS: Alanine, glutamate-glutamine and glutathione levels are elevated. pMR-high rCBV.^[3]

Fig. 8: T1WI axial post contrast showing meningioma.

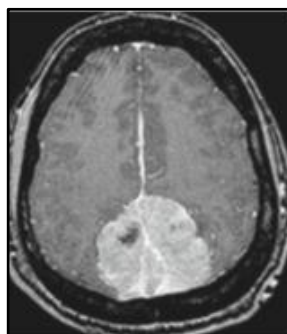


Fig. 8

CONCLUSION: The MRI diagnosis in case of posterior fossa tumors was found to correlate with the histopathologic diagnosis in most instances. The positive predictive value of MR was found to be 92.8%. Due to advanced neuro imaging we are becoming better at making a preoperative diagnosis of that tumor type, detecting recurrence, and guiding surgical management to avoid injury to vital brain structures resulting in better outcome for children who have future awaiting for them.

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REVIEW ARTICLE

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