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Posterior Fossa Brain Tumors of Adults: A Radiographic MRI Overview

Open Access **Review Article**

Mohamed Elashry*

Diagnostic Radiology and Medical Imaging, Faculty of Medicine, Mansoura University, Egypt

***Address for Correspondence**

Mohamed Elashry, Diagnostic Radiology and Medical Imaging, Faculty of Medicine, Mansoura University, Phone:3528700622, Address: Elgomhoria Street, zip code: 33516, Mansoura, Egypt

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Introduction

Primary brain tumors are originating from the main component cells of the brain (with sole exception of microglial cells) and from the supporting tissues. In childhood, tumors arise from more primitive cells (e.g. neuroblastoma, medulloblastoma) *[1]*. Posterior cranial fossa tumors constitute about 50% of pediatric brain tumors *[2]*. In infants supratentorial tumors are more common, and children older than 4 years showed a high frequency of infratentorial tumors. As well as around 45-60% of the brain tumors are infratentorial tumors *[3]*.

Brain metastasis

Metastases to the brain constitute the most common intracranial tumor in adults. Nearly about 40% of intracranial neoplasms are metastatic. Colon cancers are considered the most common primary tumors to metastasize to the brain with a ratio of lesion situation in the cerebrum (80-85%), in the cerebellum (10-15%), and in the brain stem (3-5%) other 1ry cancers include lung, breast, skin, pancreas, testes, ovary, cervix, renal cell carcinoma and melanoma *[4]*.

Cerebral metastasis occurs most frequently at the interface of the cortex and underlying white matter interface, a result mostly related to obstruction of the penetrating arteries by flowing tumor emboli, which suddenly narrow as they join the subcortical white matter. Metastatic tumors spread to the brain through blood circulation mostly via an arterial tree and less often via pelvic and GIT venous plexus *[5]*. Most brain metastases are surrounded by excessive perifocal edema. Early diagnosis and management of brain metastasis may result in a reduction of brain symptoms and may enhance the quality of the patient's life and increase their survival rate *[6]*. MRI shows hypo intensity on T1WI, variable signal intensity on T2WI, and enhancement on post-contrast T1WI *[7]*. Melanoma has a somewhat characteristic appearance if the hemorrhage is not detected, the lesion is hyperintense in T1-WI and isointense to the brain in T2-WI this happens mostly due to the free radical content of melanin pigment *[1]*. Brain metastasis from small cell lung carcinoma shows restricted diffusion (hyperintense signal on DWI and hypointense signal on ADC map) with decreased ADC value probably due to the hypercellularity [4]. Mucinous adenocarcinoma and hemorrhagic metastases may be isointense on T2-weighted images from calcification and chronic blood leak. Contrast-enhanced MRI is considered a valuable technique for the evaluation of intracranial metastatic disease. Following contrast administration, different patterns of enhancement have been noted as solid, ring, heterogenous or serpiginous *[7]*. Contrast enhancement on MRI easily differentiates the margins of the metastasis from the surrounding perifocal edema, a distinction which is not often allowed on pre-contrast T1 or T2 WI. This implies the important role of contrast injection to visualize and differentiate the metastatic lesion *[1]*.

Hemangioblastoma

Hemangioblastomas are benign, vascular tumors that represent 1 to 2.5% of all intracranial neoplasms. They were detected in the spinal cord as well as the cerebellum. A rich vascular bed is one of the main characteristics of hemangioblastomas. The tumor is characterized by a homogenous and strong contrast enhancement by MRI with T1 iso- to hypointense and T2 hyperintense. Calcium content within this tumor is extremely rare *[8]*. Hemangioblastoma shows an iso to hypointense as well as T2 hyperintense by MRI. On MRI, these tumors appear T1 iso to hypointense and T2 hyperintense. A homogenous and strong contrast was detected in the solid component of hemangioblastoma. Prominent and serpiginous supplying vessels may be rarely seen on MRI. MR angiography (MRA) and MR venography (MRV) are very important in detecting supplying vessels and confirming the diagnosis and helping to differentiate hemangioblastoma from JPA *[9]*. Multiple tumors in the brain and spinal cord are nearly constantly correlated with von Hippel-Lindau disease *[8]*. On DWI, the solid component shows (hypointense signal on DWI and hyperintense signal on ADC map) with increased ADC value which indicates the low cellularity of the tumor. This finding is useful in the differential diagnosis of these tumors. The cystic components of the mass display the free diffusion properties the same as (CSF) diffusion properties *[10]*.

Meningioma

Meningioma constitutes about 15% of all intracranial tumors

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and is the most common extra-axial space-occupying tumor *[11]*.It constitutes about 0.4-4% of all pediatric brain tumors. Surface meningiomas arise from the arachnoid cells implanted in the dura, while the intraventricular meningiomas arise from pia-arachnoid cells. The tumors mainly have a dural based attachment. Meningiomas are more common in women than men. They have a predilection to occur from the 3rd to 6th decades of life. They are extremely rare in patients younger than 20 years and if it exists, it is commonly are associated with NF type II *[4, 12]*. Most commonly they are seen parasagittally (25%). Others include the convexity (20%), sphenoid ridge (15-20%), olfactory groove (5-10%), posterior fossa (10%), intraventricular region (2%) and extracranial region (1%). Focal calcification is seen in 25% of cases, although hyper density on CT is observed in most cases *[13]*. On MRI, extra-axial tumor with the homogenous isointense signal on T1WI and T2WIs, dense homogenous enhancement on post-contrast T1WIs with a dural tail *[14]*. The signal characteristics of meningiomas on DWI are variable according to their type. Most of the benign meningiomas show intermediate diffusion (isointense signal to normal white matter on DWI and ADC map) with ADC value near that of normal brain white matter.Malignant or atypical meningioma usually displays restricted diffusion (hyperintense signal on DWI and hypointense signal on ADC map) with decreased intratumoral ADC values than benign meningioma *[11, 14]*.

Acoustic Schwannoma

Schwannomas are derived from Schwan cells and fibroblasts. They frequently arise from the intra canalicular portion of the 8th nerve frequently vestibular branch (acoustic neuroma) but can also originate from the 5th or 7th cranial nerves. Bilateral acoustic schwannomas are one of the diagnostic criteria of NF-II *[15]*. On MRI, well-delineated mass is seen along the cranial nerves, homogenous on T2WIs when small, heterogeneous on T2WIs when large, and on post-contrast T1WI it shows variable contrast enhancement *[14]*. On DWI, it shows free diffusion (hypointense signal on DWI and hyperintense signal on ADC map) with a high ADC value that can be useful to differentiate it from meningiomas. The ADC values of schwannoma are significantly higher than those of meningioma *[11, 14]*.

Tumors like cystic lesions

Epidermoid Tumors

Epidermoid cysts are benign neoplasms of ectodermal origin and about 50% of epidermoid tumors are seen in the cerebellopontine angle (CPA) *[16]*. Most epidermoid cysts have a lobulated appearance and show a special MRI appearance consisting of T1WI that shows low SI, T2WI that shows high SI, and FLAIR images. They are hyperintense relative to the CSF *[17]*. On DWI, The ADC value of epidermoid tumors is lower than those of the CSF and equal to that of brain parenchyma (0.82×10-3 mm2/s) *[11, 14]*.

Teratoma (Dermoid cyst)

Midline mass containing calcification, soft tissue, cysts, and fat. It embraces the midline, optic chiasm, and pineal gland. On MRI, T1WI shows high SI from fat, the variable signal from calcification, T2WI shows soft tissue components isointense and on T1 post-contrast soft tissue may show enhancement *[18]*. On DW imaging, the solid portion shows restricted diffusion (hyperintense signal on DWI and hypointense signal on ADC map) with decreased ADC value *[11, 14]*.

Arachnoid Cysts

Arachnoid cysts are benign, congenital intracranial cysts. They do not communicate with the ventricular system. They are representing about 1% of all intracranial masses. Most of the arachnoid cysts are supratentorial and about 50 % are found in the middle cranial fossa, anterior to the temporal lobes overlying on the greater wing of sphenoid bone. On MRI, it has the same signal intensity as CSF at all sequences *[19, 20]*. On DWI, it shows free diffusion (hypointense signal on DW images and hyperintense signal on ADC map) with ADC value near that of brain CSF (2.82×10-3 mm^2/s) *[20-22]*.

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