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Original Research Article

Role of MRI in Evaluation of Posterior Fossa Tumours

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Abstract

Introduction: Magnetic resonance imaging has been one of the most spectacular advances and has practically revolutionized the diagnosis of brain tumours. MRI scan is more accurate in diagnosing infratentorial brain tumours than CT. Presence of various characteristics like hemorrhage, necrosis, edema, mass effect and neovascularization are all better evaluated with MRI than with CT scan. Hence, MRI is generally the investigation of choice in characterization of them.

Materials and Methods: The study was conducted on 60 patients in the department of Radiodiagnosis, C.U. Shah Medical College, Surendranagar, Gujarat for a period of 24 months from Feburary 2015 to Feburary 2017.

Observations: Most of patients were above 50 years of age with largest age group between 51-60 years. Cerebellum was most commonly involved part of brain in 27 patients. Most common pathological subtypes were metastases. Next most common pathological type of tumour in the present study was schwannoma. Other tumours included ependymoma, arachnoid cyst, epidermoid cyst, pilocytic astrocytoma and glioma.

Conclusion: MRI showed exquisite sensitivity in detecting haemorrhage, necrosis, edema as well as extension of the tumours to other sites and internal auditory canal in case of acoustic schwannoma. Advanced MRI techniques like DWI and MRS helped to diagnose all suspected malignant lesion noninvasively with fair accuracy which was not possible with CT. The salient advantages of MRI thus are its ability to tissue characterize the lesion, detect haemorrhage, necrosis and edema accurately, ability to differentiate malignant from benign lesions non-invasively and most importantly lack of ionizing radiation. Keywords: Posterior fossa, Metastasis, Schwannoma, Meningioma.

INTRODUCTION

Magnetic resonance imaging (MRI) has been one of the most spectacular advances in medicine and has practically revolutionized the diagnosis of brain tumours.

During the last few years, advances in MRI techniques have led to fast scan times and improved image quality and considerably widened the scope of MRI. With advent of fast spin echo (FSE), turbo spin echo (TSE), gradient echo (GRE) and echo planar imaging (EPI) techniques, MRI brain is possible in just a few minutes and even less, thus obviating the potential possibility of motion artifacts.

MRI scan is more accurate in diagnosing infratentorial brain tumours than CT as CT has the considerable disadvantage of beam hardening artifact and MRI has a unique ability of tissue characterization. Presence of various characteristics like hemorrhage, necrosis, edema, mass effect and neovascularization are all better evaluated with MRI than with CT scan. Introduction of various advanced MRI techniques like Diffusion weighted imaging (DWI) and Magnetic Resonance spectroscopy (MRS) has revolutionalized the differentiation of malignant etiology from the benign ones.

Contrast enhanced MRI (CEMRI) adds near perfection to the diagnosis of brain tumours and minimizes false positives. Because of the presence of different operative approaches and treatment strategies for the posterior fossa neoplasms, accurate preoperative diagnosis became a very important goal in patients with posterior fossa neoplasms. With the limited utility of CT scan in the differential diagnosis of various brain tumours, MRI is generally the investigation of choice in characterization of them.

MATERIALS AND METHODS

The study was conducted in the department of Radiodiagnosis, C.U. Shah Medical College, Surendranagar, for a period of 24 months from Feburary 2015 to February 2017. 60 patients were evaluated with detailed history, clinical

examination and MRI was performed using T1, T2, FLAIR, DWI, GRE & T1 post Gd images using SIEMENS 1.5T MRI.

RESULTS

The present study included 60 cases of patients with infratentorial space occupying lesion. Following observations were made according to age, sex, symptoms and MR appearances of the various lesions and the study data was analyzed.

Age(in years)	No. of Pts.	Percentage
1-10	4	6.6%
11-20	6	10%
21-30	4	6.6%
31-40	3	5%
41-50	11	18.3%
51-60	15	25%
61-70	13	21.66%
71-80	4	6.6%
81-90	0	_

In our study, most of patients were above 50 years of age (53.33% of all patients) with largest age group between 51-60 years (25% of all patients). Youngest patient was having 4 Year old with Medulloblastoma and the oldest patient was 79 year old having Meningioma.

Table-2: Location

INTRA AXIAL	EXTRA AXIAL
31	29

Out of 50 cases of Posterior fossa SOLs, 31 (51.66%) were intra-axial lesions and 29 (48.33%) were extra-axial lesions.

Table-3: Parts Involved

Part Involved	No. of Pts.
Cerebellum	27
Brainstem	2
4 th ventricle	4
CP angle	22
Others	5

The cerebellum was most commonly involved part of brain in 27 (45%) patients. Many of these patients had simultaneous involvement of 4th ventricle also. Next most common site of tumourswas the CP angles. In decreasing order of involvement, were 4th ventricle- 4 patients,

brainstem - 2 patients and other sites (like between the two cerebellar hemispheres, at tentorial apex, cerebral convexity and on both sides of tentorium cerebelli)

Table-4: Signal Intensity on Conventional MRISequences

Sequences	Signal	No of	Percentage
		Pts	(%)
T1WI	Нуро	18	30%
	Hyper	0	_
	Iso	15	25%
	Heterogenous(Mainly Hypo)	27	45%
T2WI	Нуро	1	1.6%
	Hyper	20	33.33%
	Iso	4	6.66%
	Heterogenous(Predominantly	35	58.33%
	Hyper)		
FLAIR	Non-suppressed	40	66.66%
	Partial suppressed	16	26.66%
	Total suppression	4	6.66%

In present study on T1WI most of the tumours were heterogeneously hypointense (27 patients-45%) or hypointense (18 patients-30%). The internal heterogeneity was attributed to presence of hemorrhage (mostly subacute) or calcification. Then followed isointensity on T1WI mostly in cases of schwannoma or meningioma.

Most of the lesions demonstrated heterogeneously hyperintense (35 patients – 58.33%) signal on T2WI which was most probably due to necrotic or cystic components. Then followed purely hyperintense, isointense and hypointense lesions.

Most of the tumours were non-suppressed on FLAIR images (40 patients-66.66%). The lesions which showed partial suppression were chiefly solid-cystic lesions with suppression of fluid elements along with the epidermoid lesions.

4 patients (6.66%) in our study showed total suppression on FLAIR images which included 3 cases of arachnoid cysts and 1 case of cystic schwanoma.

Table- 5: Signal Intensity on Advanced MrRISequences

Sequences	Signal	No of	Percentage
		patients	
DWI	Restriction	33	55 %
	No Restriction	27	45 %
GRE	Blooming	21	35%

33 patients (55 %) of present study showed restriction of diffusion on DWI.

In our study, 9 patients had equivocal scans so they underwent MR Spectroscopy exam and showed elevated Cho and Cr peaks with reduced NAA.

Table – 6: Enhancement

Enhancement	No. of Pts.	Percentage
Heterogenous	28	46.66%
Homogenous	14	23.33%
Rim	6	10%
No enhancement	10	16.66%

In our study, most of tumours (50%) show some enhancement, most common being heterogenous/ inhomogenous enhancement. 10 patients (16.66%) did not show any enhancement which included mainly epidermoids and arachnoid cysts.Most common tumours to show homogenous enhancement were schwannoma and meningioma.

Table-7:Hydrocephalus&CisternalCompression

	No. of Pts.	Percentage
Hydrocephalus&Cisternal	39	65%
effacement		

Most of the tumours (39 patients-65%) showed hydrocephalus due to compression of 4th ventricle, however 1 patient had shown it due to aqueductal compression.

Most tumours showed effacement of adjacent cisterns, most commonly preportine and bilateral/ipsilateral CP angle cisterns.

Table –8: Hemorrhage & Necrosis

	No. of Pts.	Percentage
Hemorrhage& Calcification	20	33.33 %
Necrosis	31	51.66%

Most of the tumours showing hemorrhage were metastatic lesions (patients- 33.33%) from primaries such as renal cell carcinoma and medullary Carcinoma of thyroid. Then were other tumours like schwannoma, glioma, ependymoma, medulloblatoma.

Most of the tumours (31 patients –51.66%) showed necrotic components within due to high grade of tumour. These included metastasis, glioma, ependymomas and schwannomas.

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Table – 9: Edema, Mass Effect, Neuro-Vascular& Bony Changes

	No. of Pts.	Percentage
Edema& Mass effect	46	76.66%
Neuro-vascular	14	23.33%
involvement		

Most of the tumours (46 patients-76.66%) showed edema and mass effect.

Neuro-vascular involvement was mainly seen in schwannomas and some of the meningiomas.

Bony changes are related to widening of internal acoustic meatus in schwannoma.

Table–10:DiagnosisandFrequencyofDistribution

Final diagnosis	No. of	Percentage
_	Pts.	
Acoustic schwannoma	15	25%
Metastases	17	28.33%
Medulloblastoma	2	3.33%

Meningioma	5	8.33%
Cerebellar glioma	2	3.33%
Hemangioblastoma	2	3.33%
Brainstem glioma	2	3.33%
Pilocytic astrocytoma	5	8.33%
Ependymoma	1	1.6%
Epidermoid	6	10%
Arachnoid cyst	3	5%
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Most common pathological subtypes were metastases having 28.33 %.

Next most common pathological type of tumour in the present study was schwannoma.

Next most common were glioma having a total 16.66% of cases, which was comprised by Brainstem glioma(3.33%), Pilocytic astrocytoma (8.33%), Cerebellar high grade glioma(3.33%) and Ependymoma(1.6%).

Then were Epidermoids (10%), meningioma (8.33%), arachnoid cysts (5%) medulloblastoma (3.33%), hemangioblastoma(3.33%).

OBSERVATIONS FIGURE 1



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Well define lesion noted in left cerebeller hemisphere which appear heterogenously hypointense in T1W & heterogenously hyperintense on T2W image. On FLAIR perilesional edema noted.No restriction on DWI. Blooming on GRE. ON contrast heterogenous enhancement. Findings are suggestive of metastasis.

FIGURE 2



Well define extra-axial solid cystic lesion noted in right cerebello-pontine angle extending in to internal acoustic canal which appear hypointense on T1w image heterogeneously hyperintense on T2W image, no perilesional oedema on FLAIR, and no diffusion restriction suggest schwannoma. On FLAIR no peripheral oedema. No restriction on DWI. Findings suggestive of acoustic schwannoma.

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FIGURE 3



Well defined extra-axial lesion in left cerebello-pontine angle appear hypointense on T1W and hyperintense on T2W image. No perilesional oedema and no diffusion restriction suggest meningioma.

FIGURE 4



Heterogeneous lesion in left cerebellopontine angle which appears hypointense on T1, hyperintense on T2, dirty signal on FLAIR and shows diffusion restriction, suggestive of epidermoid cyst.

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FIGURE 5



Cyst with solid nodule located in left cerebellar hemisphere. The nodule appear hypointense on T1W and T2W image. On FLAIR there is perilesional oedema. DWI shows no diffusion restriction. There is heterogeneous enhancement of nodule with rim enhancement of cyst wall. Findings suggest pilocytic astrocytoma.

FIGURE 6



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Well defined lesion located in 4th ventricle which appears hypointense on T1W, hyperintense on T2W images and shows diffusion restriction, suggestive of Medulloblastoma.

DISCUSSION

Metastases

In our study, metastasis is the most common posterior fossa tumour constituting 28.33% of all patients. 11 out of 17 patients had hemorrhagic metastasis. A study conducted by Kathleen R. Fink et al showed that Imaging characteristics of metastases may suggest an underlying pathologic diagnosis. Metastases that classically hemorrhage include melanoma, choriocarcinoma, renal cell carcinoma, and thyroid cancer. Lung metastases are also known to hemorrhage. Of all hemorrhagic metastases, however, lung and breast cancers are the most common etiologies due to their higher overall prevalence^[1].

Acoustic schwannoma

Acoustic schwanoma is most common cerebellopontine cistern mass,accounting 85-90% of lesion in this location. Acoustic schwanoma are generally isointense with brain on T1WI & heterogeneously hyperintense on T2WI^[2]. In our study, there were patients of acoustic schwanoma with similar findings.

Medulloblastoma

In our study, all the cases of medulloblastoma were below the age group of 10 years and all cases showed hydrocephalus and DWI restriction. Histological classification of medulloblastoma includes classic and variants (desmoplastic/ nodular, medulloblastoma with extensive nodularity, anaplastic& large cell medulloblastoma)^[3]. Anaplastic medulloblastoma subtype was associated with increased ADC and with ring enhacement. These features could be considered in the evaluation of high-risk medulloblastoma subtype.^[4]

Pilocytic astrocytoma

There is contradictory evidence in the literature regarding the most common location of PA in the cerebellum. In Hyostek CJ et al. study , in a series of 132 patients, 16 % of tumours arose in the vermis, 53 % in the cerebellar hemisphere, and 26 % in both; 34 % also involved the brainstem. However, in Pencalet P et al. review of 168 cases, 71 % of PA tumours were located in the vermis, while 29 % occurred in the hemisphere^[5]. In our study out of 5 cases , 3(60%) cases were in cerebellar hemisphere.

Cerebellar astrocytoma (Of higher grade than Pilocytic variety)

These comprised fourth most common tumour group in present study with an age range of 15 years-57 years and mean age of 30.16 years. Most common symptoms were headache vomiting and convulsions.

The tumour was equally located in right and left cerebellar hemisphere and vermis, two cases at each location. The tumours were mostly heterogenouslyhypointense on T1WI and heterogenouslyhyperintense on T2WI with

necrotic foci. The necrotic foci showed suppression on FLAIR images. One tumour showed homogenous.

No restriction of diffusion on DWI. Two indeterminate lesions of the above lesions underwent MR spectroscopy and showed raised Cho and Cr peaks along with reduced NAA peak intratumourally as well as in perilesionaledema. Mass effect was seen in both patients with hydrocephalus in one patient and cisternal compression in both patients.

Brainstem glioma

75% of brainstem glioma occur in patients younger than 10 years. The peak incidence of brainstem glioma is in patients 3-10 years old^[6]. In our study, all cases are below 10 years age.

On MRI, diffuse pontinegliomas characteristically expand the pons & are usually and hypointense relative to gray matter on T1- weighted images and hyperintense relative to gray matter on T2weighted and FLAIR images. Most brainstem gliomas do not enhance; however if they do enhance, enhancement is very little and heterogenous^[6].

Hemangioblastoma

Hemangioblastoma most commonly oocur in men than women,with the highest incidence in third and sixth decades. A cerebellar hemangioblastoma present as isolated finding or as manifestation of von hippel-lindaudisease^[7].In our study one case is of vonhippel-lindau disease.

Meningioma

Dural tail sign, "dural thickening", "flare sign", "meningeal sign" are similar terms describing thickening of the dura adjacent to an intracranial neoplasm on contrast-enhanced T1W images.

Triple criteria for dural tail sign are: (1) Presence of at least two consecutive sections through the tumor at the same site in more than one imaging plane; (2) Greatest thickness adjacent to the tumor and tapering away from it; and (3) Enhancement more intense than that of the tumor itself^[8]. In our study, all cases of meningioma show dural tail sign.

Ependymoma

Forty percent of ependymomas are supratentorial, 60% infratentorial while are in location .Ependymomas may manifest at any age with no predilection. gender The posterior fossa ependymoma arises most often in children (mean age, 6 years). The supratentorialependymoma generally manifests in an older age group (mean age, 18–24 years)^[9]. In our study, all cases of ependymoma are below 10 years.

Epidermoid cyst

Radiologically, epidermoids may be seen as extraaxial lesions in the basal cisterns growing along the CSF spaces encasing vessels and nerves and causing a disproportionately less distortion of the surrounding brain.

On T1-weighted images, epidermoid appears hypointense to the gray matter and slightly hyperintense to CSF. On T2-weighted images, the lesion is hyperintense to gray matter and similar to that of CSF. However, heterogeneity of the signals is seen commonly. Diffusion-weighted images show restricted diffusion making the lesion hyperintense. CSF and arachnoid cysts appear hypointense as there is no restricted diffusion. Fluid-attenuated inversion recovery (FLAIR) images and constructive interference in steady state (CISS) 3-D images are also useful in diagnosing this condition. In the former sequence, epidermoid appears heterogenous the and hyperintense to CSF; while in the latter, the lesion appears heterogenous with hypointense and hyperintenseareas^[10]. In our study all cases shows DWI restriction & dirty signal on FLAIR. There is no contrast enhancement.

Arachnoid cyst

The intracranial locations of the ACs are middle cranial fossa, quadrigeminal cistern, retrocerebellar cistern, cerebral convexity, and cerebellopontinespace^[11].

In our study, None of the patients had more than one cyst, and none had associated developmental malformations. Headache, and epileptic seizures were the most frequent presenting symptoms. In onecase, ACs were diagnosed incidentally.

CONCLUSION

All of the tumour lesions were demonstrated well on MRI with many of the lesions better seen on MRI than CT scan. CT is less helpful in posterior fossa tumours because of beam hardening artefact. MRI showed exquisite sensitivity in detecting haemorrhage, necrosis, edema as well as extension of the tumours to other sites and internal auditory canal in case of acoustic schwannoma. In most of the findings MRI was better in depicting the abnormalities with high sensitivity and specificity.

Advanced MRI techniques like DWI and MRS helped to diagnose all suspected malignant lesion non-invasively with fair accuracy which was not possible with CT. The findings of these techniques combined with conventional techniques have proved the superiority of MRI far ahead of CT.

The salient advantages of MRI thus are its ability to tissue characterize the lesion, detect haemorrhage, necrosis and edema accurately, ability to differentiate malignant from benign lesions non-invasively and most importantly lack of ionizing radiation. Sometimes even in patients with reaction to iodinated contrast media in whom CT is contraindicated, MRI proves invaluable.

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