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SPECIFIC DIAGNOSIS OF MASSES IN THE BRAIN STEM REGION ON THE BASIS OF MRI CRITERIA

By

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ABSTRACT:

Twenty six patients were presented with clinical signs of brain space occupying lesion, all patients were studied by plain X-ray skull and CT brain before and after Intravenous contrast injection. All patients were examined by MRI to verify if MRI will detect the lesions, if specification of the lesion can be possible and if MRI will add more for the diagnosis of brain stem lesions. The diagnosis was confirmed by laboratory results, imaging characteristics, surgical findings and follow up response to anti-TB therapy in cases suspected to be tuberculoma. Certain MR signal patterns were found to be characteristics for some lesions which help in specific diagnosis.

In most conditions the diagnostic value of CT is often equal to that of MRI, however MRI demonstrats the lesions better, whether they are intra or extra axial and their relations to the surrounding structures

INTRODUCTION:

Brain stem masses is difficult group to analyze, since in many cases biopsy proof is not available for confirmation.

Brain stem masses are the most homogenous in appearance of all the posterior fossa masses. As brain stem gliomas are usually slow growing, the 4th ventricle and aqueduct are usually stretched over the tumor and remain open.

Hydrocephalus is uncommon in brain stem tumors. MR Imaging and CT has similar abilities for demonstration of brain stem masses, however the visibility of the lesions is often better with MRI (7). CT Scan is still an important diagnostic tool for tuberculomas having certain characteristic findings, this may explain why since the advent of MRI only few reports were published about the common MR signal patterns of intracranial tuberculoma(23).

The absence of beam hardening artifacts, multiplaner imaging capability and greater intrinsic soft tissue contrast are

emphasized as significant advantages of MR Imaging in the assessment of brain stem masses (14).

This study is aimed to assess the diagnostic efficacy of MRI before and after contrast enhancement in the evaluation of specific diagnosis of brain stem masses.

MATERIAL and METHODS:

Twenty six patients with intraxial and extraxial brain stem tumors were included in the present study, their ages ranging from 3 to 70 years. Forteen males and twelve females were examined by MRI in Radiodiagnosis Departments, Cairo University, Maady Military Hospital and other private MR centers.

They were suspected clinically and were diagnosed by plain X-ray and CT then confirmed by MRI. The CT and plain X-ray were done in Al-Hussien and Bab El-Shaaria University Hospitals. Suitable sedation was used for children and irritable patients.

When imaging the brain stem it is mandatory to acquire thin (3-5 mm) axial proton density and T2-weighted images with inplane spatial resolution of 1 mm or less. Flow compensation is useful for both echoes of long TR sequence since the signal from pulsating C S F in the basal cisterns tends to degrade the image. TRs should be at least 2,000 m sec at middle field strengths and 3000 msec at heigh feild strengths.

Thin 3-5 mm T1-weighted sagittal and coronal images are needed for lesion characterization and localization.

Enhancement with gadopentetate dimeglumine may be useful to characterize blood-brain barrier breakdown. A dose of 1-2 m mol/kg body weight was intravenously injected.

RESULTS:

twenty six patients with brain stem tumor were examined by MR before and after Intravenous contrast injection.

The clinical findings included one or more of the following:

Papilloedema or other signs of increased intracranial tension in 18 patients. Epileptic seizures in 7 patients. Sensory or motor manifestations in 20 patients. Retrospective studies of the X-ray and CT findings as demonstrated in table 1 are:

Plain X-ray of the skull in AP and lateral views showed evidence of increased intracranial tension in 11 patients, likely due to obstructive hydrocephalus rather than the tumor. C T brain before and after Intravenous contrast demonstrated the tumor in 26 patients. No tumor was missed by CT.

As regards to the number of lesion it was single tumor, no multiple brain stem tumors were detected except in two cases of metastasis where 2 small metastasis were seen in the pons. The size of the tumors was between 0.5 cm and 5 cm. The age of incidance was between 3 and 70 years.

Table (1): Results of different imaging modalities performed.

Image modality	No. of cases	+ve cases	+ve cases
X-ray Skull	26	11	15
C T Brain	26	26	0
M R I Brain	26	26	0

MRI findings are sown in table 2.

Case No.	Size of lesion	Type	Site	Age	T1 intensity	T2 intensity	Post contrast pattern
1	3.0 cm	Glioma	Pons	7	Hypointense	Hyperintense	Homog.
2	0.9 cm	Glioma	Pons	5	„	„	„
3	4.0 cm	Glioma	Pons	6	„	„	heterog.
4	3.5 cm	Glioma	Pons	4	„	„	homog.
5	2.1 cm	Astrocyt	M. Oblong.	4	„	„	Enhance
6	2.8 cm	Ependy.	4th vent.	3	„	„	dense
7	3.0 cm	„	„	4	„	„	„
8	2.5 cm	„	„	5	„	„	„
9	2.0 cm	„	„	4	„	„	„
10	5 cm	Medullobl astoma	Vermis	5	„	„	Enhance.
11	3.3 cm	„	„	7	„	„	Faint
12	3 cm	„	„	9	„	„	„
13	0.8 cm	Choroid plexus Papill	„	5	Isointense	Isointense	„
14	0.7 cm	„	„	7	„	„	„
15	0.7 cm	„	„	9	„	„	„
16	0.9 cm	Cav. Angioma	Pons	42	Hypointense	Hyperintense hypointense rim	„
17	1.1 cm	„	Mid brain	37	Mixed	„	„
18	0.8 cm	Haemangi oblastoma	Med. oblong.	43	hyperintense	hyperintense	dense
19	0.8 cm	metastasis	Mid brain	50	hypointense„	„	marked enhanc.
20	0.5 cm	2 metastasis	Pons	55	„	„	„
21	0.5 cm	2 metastasis	„	57	„	„	„
22	3.0 cm	2 metastasis	„	70	„	„	Ring enhanc.
23	1.5 cm	Tuberculo ma	„	20	Isotense	Hypointense area from outside ie central hyperintense zone	„
24	2.5 cm	Tuberculo ma	„	30	„	„	„
25	2.0 cm	Tuberculo ma	„	41	„	„	Homog. enhanc.
26	2.5 cm	Tuberculo ma	„	55	„	„	Ring enhanc.

Cases of metastasis were detected after age of 50 years. Vascular tumors were seen after age of 30 years.

Four cases of glioma were seen in the pons, the age of incidence was between 4 and 7 years with male predominance, 3 males and 1 female. MRI showed well defined mass expanding the pons hypointense in T1-weighted imaging and hyperintense in T2-weighted (Fig. 1). The masses showed homogenous enhancement except one case showed heterogenous enhancement. This tumor was 4 cm in diameter, it was the largest one and the only one to show mass effect in the form of obstructive supratentorial hydrocephalus (Fig. 2).

One case of astrocytoma was located in the medulla oblongata in a child 4 years old. It showed a hypointense lesion expanding the medulla and extending to the upper cervical. After Intravenous contrast injection it showed homogenous enhancement of the lesion, suggestive of low grade astrocytoma.

Four cases of ependymoma located in the 4th ventricle, appeared well defined, the age of incidance was between 3 and 5 years. The tumors were of low intensity in T1-weighted and hyperintense in T2-weighted images. All ependymomas showed dense enhancement after intravenous injection.

Three cases of medulloblastoma, the age of incidance was from 5-9 years, all cases were located in the vermis and showed peripheral surrounding tortous vessels. MRI showed soft tissue mass of slightly diminished signal intensity on T1-weighted images and increased signal intensity on T2W1. After intravenous contrast injection the tumor showed homogenous enhancement (Fig. 3 a & b).

Three cases of choroid plexus papillomas, their ages ranged between 5 and 9 years , the three patients were male, the lesions were located in the 4th ventricles, their size was less than 1 cm, and the three patients had hydrocephalus. MRI showed a lobular intraventricular mass of homogenous, isointense, T1-weighted images and high signal intensity on T2-weighted, contrast injection showed enhancement of the lesion (Fig. 4).

Two cases of cavernous haemangioma, one was located in the pons and the other in the mid brain, age incidance was 37 and 42 years respectively. MRI showed the tumor as small circumscribed lesion hyointense on T1 and hyperintense on T2-weighted images. A hypointense rim on T2-weighted images was seen (Fig. 5).

One case of haemangioblastoma in a patient aged 43 years was seen in the medulla oblongata, the tumor was seen well with lengthening of T2 (Fig. 6 a). SE 1600/35 the tumor is now less visible but two different parts of the lesion are recognizable (Fig. 8 b). On T1 weighted the tumor was seen hypointense and after contr Ast administration the tumor showed hyperdense enhancement with peripheral feeding vessels (Fig. 6 a & b).

Four cases of metastases, the age incidance was above 50 years, in three cases the metastasis were in the pons and one case was located in the mid brain. Single metastasis was detected in 2 cases, one in the mid brain and the other in the pons and two metastatic lesions in two patients were seen in the pons. Peritumoral

oedema was prominent feature in all the lesions. T1-weighted images showed the lesions to be hypointense and T2 showed the lesions to be hyperintense. After intravenous contrast injection moderate enhancement was noted in two cases and marked enhancement in the other two cases. The primary was in the lung in two cases and the breast in other two cases (Fig. 7).

Four cases with tuberculoma were detected in the pons, the pre contrast MR images in most cases was hypointense to the cerebral grey matter in T1 images. In T2 images they showed peripheral hypointense area with central bright zones (Fig. 8 a). The post contrast MR images showed either ring-like enhancement around the lesion or homogenous dens enhancement (Fig. 8 b). oedema was detected in the 4 cases. Mild hydrocephalus was found in 3 cases. The four cases showed definite clinical improvement after long course of antituberculous treatment and follow up after 10-15 months showed complete disappearance of the lesions.

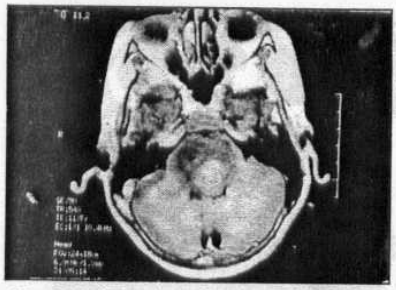

Fig. 2: Axial T1 W1 after Godalium injection shows heterogenous enhancement of a big glioma of the pons.

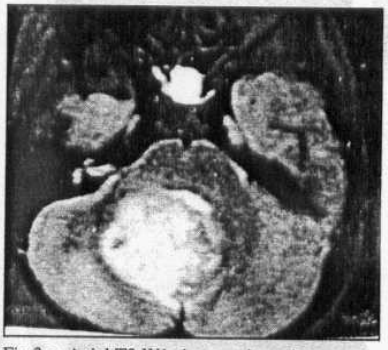

Fig.3 a: Axial T2 W1 shows, a hyperintense medulloblastoma, compressing the fourth ventricle

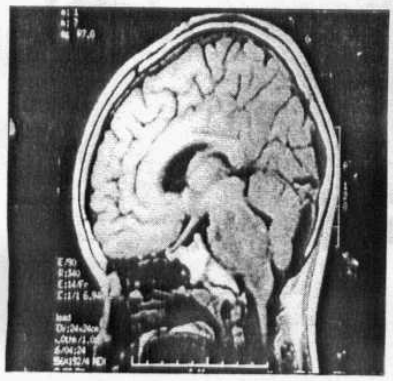

Fig. 1: Sagittal T1 W1 shows, a hyperintense pontine glioma.

Fig. 3 b: Sagittal T1W1 after contrast injection shows enhancement of the

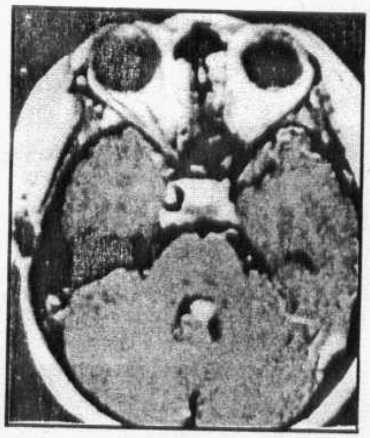

Fig. 4: Axial T1 W1 after I. V. contrast injection shows, enhancement of the choroid plexus papilloma within the fourth ventricle.

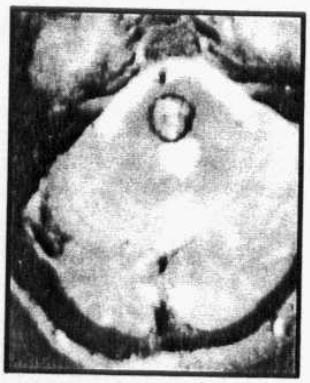

Fig. 5: Axial T1 W1 shows, non homogenous mixed signal haemangioma with hypointense rim.

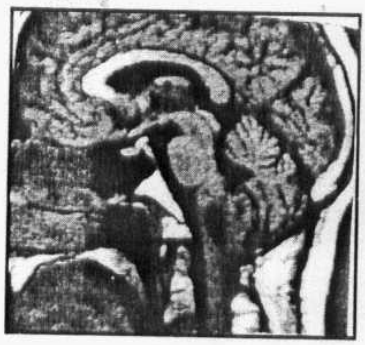

Fig. 6 a: Sagittal T1 W1, SE 400/35 shows, the tumor hypointense.

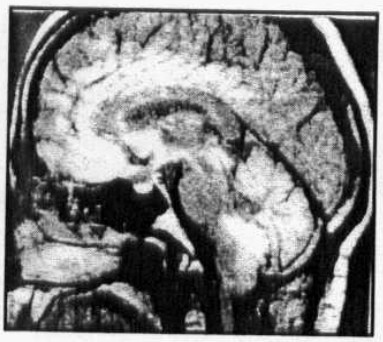

Fig. 6 b: Sagittal T2 W1, SE 1600/35 shows, hyperintense haemangioblastoma involving the medulla oblongata with peripheral feeding vessel.

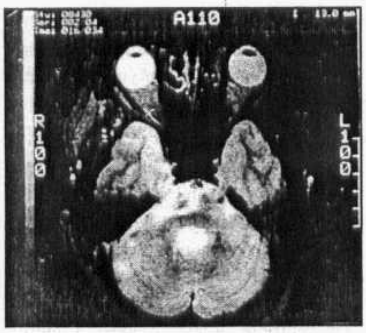

Fig. 7: Axial T2 shows hyper and isointense metastasis with surrounding edema in the pons

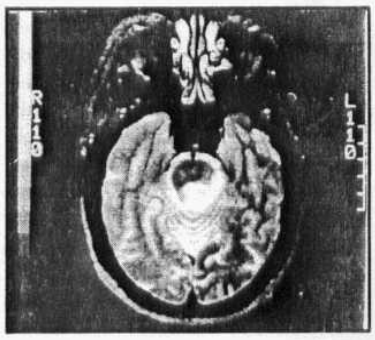

Fig. 8 a: Axial T2 W1 showing focal hyperintense area with hypointense rim and surrounding edema (Tuberculoma of the brain stem).

Fig. 8 b: Axial T1W1, post contrast showed homogenous enhancement of the tuberculoma.

DISCUSSION:

MRI is the most sensitive imaging modality for detecting glioma (2). The peak age for the onset of brain stem gliomas is around 5 years with males slightly more frequently affected than females (13). Brain stem gliomas most commonly arise from the pons (24).

In our study 4 cases of glioma were found in the pons and only one case of astrocytoma was found in the medulla oblongata. Glioma usually shows mass effect, faintly enhanced in two cases of low grade and densely enhanced in the other two cases of high grade.

Contrast administration should be routinely used in assessment of all tumors because it improves margins and a higher level of diagnostic confidence results (19).

The 4 cases showed peritumoral oedema. The vasogenic oedema results from break of the blood brain barrier that allow excessive fluid to pass from capillaries

into extracellular space, this appear on MR as iso or hypointense signal on T1 weighted and hyperintense signal in T2 weighted sequences (12).

Low grade gliomas are usually seen as non-enhancing homogenous areas of T2 prolongation (10). They are described as non-haemorragic well defined mass usually with little mass effect (4). MR may demonstrate signal abnormalities in regions of microscopic infiltration beyond the boundaries of solid neoplasm, however tumor infiltration even beyond the MR signal abnormality is often present(16).

Comparative histologic studies show that enhancement does not represent the entirety of the tumor but the maximal site of blood brain barrier disruption (6).

Necrotic central portions of tumors may be difficult to distinguish from cystic changes. Tumor cysts appear as rounded, circumscribed zones of homogenous signal usually reflecting longer T1 and T2 values than CSF (20).

In our study, we had four cases of gliomas seen in the pons and one case of astrocytoma involving the medulla oblongata. All cases showed heterogenous hypointensity on T1 and hyperintensity on T2. All cases were low grade with homogenous enhancement except for one case of routine glioma which showed large size with heterogenous enhancement, denoting a more aggressive grade.

Ependymoma occurs predominantly in children less than 5 years of age with a later but smaller peak in the third decade in adults (21). Ependymomas often pass down through the foramen magnum, a feature uncommon in other neoplasms, also sheeting of cells may spread into the spinal CSF and coating the cord itself and are best detected by contrast enhanced MRI (24). We think this picture cannot be demonstrated by CT. Ependymoma arises from ependymal lining of the 4th ventricle and tends to be slowly growing however, malignant form occur.

Four cases of ependymomas were encountered in our series, all were located in the fourth ventricle and showed dense enhancement. MRI was excellent in demonstrating the tumour origin within the fourth ventricle which allowed a more specific diagnosis of the tumour.

We found that ependymomas may mimic choroid plexus papilloma as both are located in the 4th ventricle in young age group, but ependymomas usually shows calcification which was better demonstrated by CT than MRI, choroid plexus papillomas are usually associated with hydrocephalus. Ependymoma usually shows prominent enhancement because the tumor is highly vascular. Ependymoma is usually located in the supratentorial region in adults and usually infratentorial in children. Calcification in the form of small round flecks occurs in approximately 50 % of patients, the tumor is usually low in signal intensity on T 1W 1, and may not enhance with contrast in a small percentage of patients (24).

Medulloblastoma is the commonest intracranial tumor in children, boys are more affected than girls. The tumor has tendency to seed through the CSF spaces. The tumor enhances poorly in contrast to choroid plexus papilloma which shows dense enhancement (24). The medulloblastoma rarely showed calcification helping to differentiate it from ependymoma.

In our study, we had three cases of medulloblastoma, in which MRI was very

helpful to show that the tumour was arising from the vermis and compressing the fourth ventricle and brain stem. They showed homogenous enhancement.

Choroid plexus papillomas were seen in our study in the 4th ventricle usually associated with moderate degree of hydrocephalus likely due to obstruction of the ventricular pathways and or due to stimulation of the production of CT was better in assessing meningetic sequellae with calcification. The specific MRI features of tuberculoma are isointense on T1 W1 sometimes with central hypotense, and on T2 W1 having homogenous or a peripheral thick wall of dark intensity with sometimes central bright zones. The post contrast images shows either ring or homogenous dense enhancement.

Four cases of tuberculomas were encountered in our study, showed hyperintense area with peripheral hypointense zone on T1. Three cases showed ring enhancement while one case showed homogenous enhancement after contrast injection.

In conclusion, we have found that MRI was far more superior to CT in localization of the mass, being intra axial or extra axial, with specific detection of its site of origin which allowed more specific diagnosis of tumours depending on their site, MR character on T1 and T2 and type of contrast enhancement. This was more evident in lesions arising about the fourth ventricle where MR was specific in showing the lesion arising within or outside the ventricle due to its multiplanner cabability and better resolution.

MR also showed specific features for certain tumours, like tortous vessels around haemangioblastomas, central and peripheral rings and specific enhancement of tuberculomas and was extremely specific for vascular lesions like haemangioma due to its sensitivity and specificity to certain stages of blood elements .

In summary, MRI was both more sensitive and more specific than CT in detection of brain stem lesions.

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تشخيص اورام جزع المخ على ضوء المواصفات التى يظهرها الرنين المغناطيسى

محمد كمال الشرقاوى - هانى شريف - مصطفى سمبل -
فاتن سالم- صلاح كريم ويوسف بركات

من قسمى الأشعة بطب الأزهر وطب طنطا وقسم جراحة المخ والأعصاب بطب الأزهر

هذه الدراسة أجريت على ستة وعشرون مريضا ممن اصيبوا بأورام فى منطقة جزع المخ وقد تم إكتشاف هذه الأورام بالتشخيص الإكلينيكى والأشعاعات العادية والاشعة المقطعية ثم أجريت لهم فحوصات بإستعمال الرنين المغناطيسى لبيان قيمة الرنين المغناطيسى فى التشخيص ، هل له قيمة إضافية تتفوق على باقى الفحوصات الاشعاعية وفى الحقيقة فلقد كانت النتائج التى أظهرتها الاشعة المقطعية مرضية جدا وكذلك النتائج التى أظهرها الفحص باستخدام الرنين المغناطيسى إلا إن الرنين المغناطيسى كان أكثر وضوحا وتحديدا ، أظهرت مكان الورم بدقة بالغة ودرجة تشعبه فى الأنسجة المحيطة ومدى تأثيرها به ، كما ساعد على تشخيص نوع الورم نفسه وتفرقته عن الأورام الأخرى فى معظم الحالات . كما أظهر الرنين المغناطيسى قدرة أكبر على تحديد الأوعية الدموية المحيطة بالورم ومدى تأثرهما به حتى بدون الحاجة إلى إعطاء صبغة كما فى حالات الأشعة المقطعية بالكمبيوتر .