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CHARACTERISATION OF RING ENHANCING LESIONS IN BRAIN WITH MRI AND MR SPECTROSCOPY - A SERIES OF 62 CASES

Radiodiagnosis

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ABSTRACT

Multiple ring-enhancing lesions are one of the most commonly encountered neuroimaging abnormalities. MRI's inherent sensitivity as well as its capability to directly image in any plane without reformatting, and to be unimpeded or undistorted by bony structures. Magnetic resonance spectroscopy (MRS) provides information about the possible extent and nature of changes on a routine MRI scan by analyzing the presence and/or ratio of tissue metabolites such as NAA, creatine, choline, and lactate etc.

Objectives:

- To study the characteristic imaging findings of various ring enhancing lesions and to differentiate neoplastic from non neoplastic brain lesions using conventional and advanced MR imaging techniques.
- To study the role of MR spectroscopy in the evaluation of various ring enhancing lesions in the brain with a single voxel proton MR spectroscopy.

Materials and methods: Statistical analysis of 62 cases of cerebral ring enhancing lesions detected on contrast MR studies in ASRAMS, Eluru. Conventional spin echo sequences, axial T1, T2 and FLAIR: Coronal T2; Sagittal T1; Post contrast T1 axial, coronal and sagittal; DWI; T2 GRE Single voxel spectroscopy was performed in all cases. MRI scan was performed using MR SIEMENS MAGNETOM Avanto machine 1.5T.

Duration of study: The study was carried over a period of two years from November 2015 to October 2017

KEYWORDS

MRI, ring enhancing lesions, spectroscopy, tuberculoma, glioblastoma multiformae, neurocysticercosis, abscess

INTRODUCTION:

Multiple ring-enhancing lesions are one of the most commonly encountered neuroimaging abnormalities. Widely available imaging techniques, computed tomography and magnetic resonance imaging (MRI) are used to detect these lesions. A wide range of etiologies may present as cerebral multiple ring-enhancing lesions[1,2]. MRI's clinical advantage in early detection of disease is visually demonstrated as unmistakable contrast between gray and white matter and tumor, ischaemia/infarct, edema, infection/abscess and hemorrhage. Contributing to this is MRI's inherent sensitivity as well as its capability to directly image in any plane without reformatting, and to be unimpeded or undistorted by bony structures. MR spectroscopy is a potential tool for differential diagnosis between brain abscesses and non-infectious lesions such as primary brain tumor, lymphoma, brain metastasis; and tuberculoma. Magnetic resonance spectroscopy (MRS) provides information about the possible extent and nature of changes on a routine MRI scan by analyzing the presence and/or ratio of tissue metabolites such as NAA, creatine, choline, and lactate etc.

Cysticercosis is the most common parasitic infection of the human CNS world wide. Imaging finding in neurocysticercosis are quite often characteristic. Imaging findings in each stage reflect underlying changes in the disease process and host response[3]. Cysts are common at the gray and white matter junction but are also seen in the basal ganglia, cerebellum, and brainstem. The cyst wall is thin and smooth, and a 2- to 4-mm scolex is identified within the cyst.

In a typical brain abscess with central liquefactive necrosis, the center of the cavity is slightly hyperintense to CSF, whereas the surrounding edematous brain is slightly hypointense to normal brain parenchyma on T1-weighted images. On unenhanced MR images, the mature, surgically drainable abscess often has a rim with distinctive features[4]. The rim is isointense to slightly hyperintense to white matter on T1-weighted images and is hypointense on T2-weighted images. There is smooth ring enhancement of an abscess capsule on post gadolinium MR images. Abscesses tend to demonstrate high signal intensity on DWI, with a corresponding reduction in the apparent diffusion coefficient values[5,6]. In an untreated abscess, resonances may be seen corresponding to acetate (1.92 ppm), lactate (1.3 ppm), alanine (1.5 ppm), succinate (2.4 ppm), and pyruvate, as well as a complex peak at 0.9 ppm indicating amino acids valine, leucine, and isoleucine [6-11].

CNS tuberculosis may take a variety of forms, including tubercular meningitis, abscess, focal cerebritis and tuberculoma. Tuberculomas may be single or multiple, and can be seen anywhere in the brain parenchyma. A solid caseating tuberculoma appears relatively iso- to hypointense on both T1W and T2W images with an iso- to hyperintense rim on T2W images. It shows rim enhancement on postcontrast T1W images. In vivo spectroscopy shows only lipid in T2 hypointense tuberculomas, whereas lesions with a heterogeneous appearance show Cho at 3.22 ppm along with lipid.

80% to 85% of metastases are located in the supratentorial compartment. Intraparenchymal metastases are the most common type of metastatic disease to affect the intracranial space. Most common, in decreasing incidence are lung cancer, breast cancer, melanoma, gastrointestinal cancers, renal cell carcinoma and tumors of unknown primary[12]. Most intracerebral metastases are multiple, regardless of the site of origin. Early metastatic foci are commonly found at gray matter– white matter interfaces, a feature shared by all hematogenously disseminated embolic disease. Metastases are notoriously surrounded by massive amounts of edema. Best delineated by conventional T2-weighted images rather than FLAIR. Intratumoral hemorrhage, which occurs in just less than 20% of metastases[13,14], is readily detected by MR imaging. Although many intracerebral metastases are apparent on non contrast scans, it has been well documented that intravenous contrast increases the sensitivity for the detection of intracerebral metastases. Malignant neoplasms, but not all neoplasms, demonstrate thick, irregular, or nodular enhancement, as opposed to the regular, thin, even, and smooth enhancing wall of the aforementioned benign conditions.

Glioblastoma multiforme (WHO grade IV astrocytoma) is the most common primary brain malignancy, accounting for 12%–15% of all intracranial neoplasms[15]. Glioblastoma occurs most frequently in the cerebral hemisphere of adults between 45 and 70 years of age. Conventional gadolinium-enhanced MR imaging is the standard technique for the evaluation of glioblastoma and typically demonstrates a large, heterogeneous mass in the cerebral hemisphere exhibiting necrosis, hemorrhage, and enhancement. At spectroscopy, elevation of choline and depression of NAA suggest tumor.

Pilocytic astrocytomas that arise in the supratentorial space are the most common glial tumors in the pediatric population. They

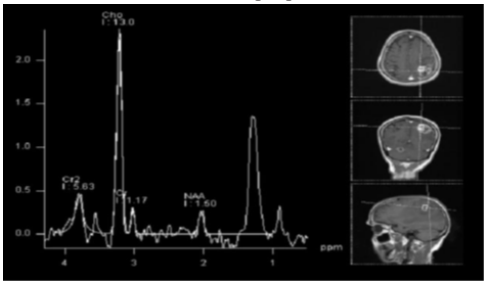
commonly occur in the optic chiasm, hypothalamus, and optic nerves and often are associated with the predisposing syndrome of NF1. They can be both cystic and solid, and they can grow as a mural nodule or form a rim around a cyst. Tumor represents mural nodule and wall of the cyst consists of compacted normal brain or non neoplastic glial tissue. Typically the solid portion of these tumors is hypointense on T1 and hyperintense on FLAIR and T2[16,17]. The contrast enhancement is usually brisk. Proton spectroscopy shows a mild elevation of choline relative to NAA and relative preservation of creatine.

Multiple ring enhancing lesions are encountered in several acute demyelinating disorders. Presence of an open ring or incomplete ring lesion helps in differentiating demyelinating lesions from large brain tumors or infective lesions like brain abscess. Demyelinating lesions, including both classic multiple sclerosis and tumefactive demyelination, may also create an open ring or incomplete ring sign.

Haemangioblastomas are tumours of vascular origin and occur both sporadically and in patients with Von Hippel Lindau (vHL). Haemangioblastomas typically occur in young to middle-aged adults. They are estimated to account for only 1-2.5% of all intracranial tumours and approximately 10% of all posterior fossa tumours. Mural nodule will be hypointense to isointense on T1WI and hyperintense on T2WI with csf signal of cyst content. Flow voids due to enlarged vessels may be evident especially at the periphery of the cyst, seen in 60-70% of cases. Mural nodule vividly enhances after post contrast imaging with gadolinium[18,19]. Cyst wall may or may not enhance.

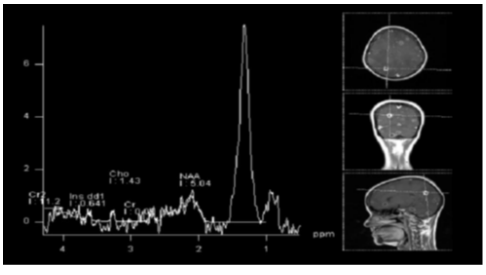
Glioblastoma multiformae

T1 isointense, T2 hyperintense thick rind line peripheral enhancing lesion with perilesional edema involving left parietal lobe. MRS shows elevated choline,reduced NAA and lipid peak.



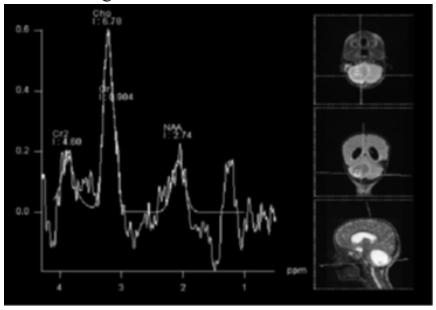
TUBERCULOMA

Multiple ring enhancing lesions involving both cerebral and cerebellar hemispheres with some of them are conglomerate in appearance.MRS shows lipid peak.



PILOCYTIC ASTROCYTOMA

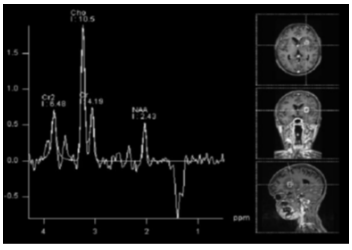
MRI shows large well defined enhancing lesion with solid and cystic components involving



right cerebellar hemisphere.MRS shows elevated Choline and reduced NAA.

CNS LYMPHOMA

In a known case of HIV with leucopenia, MRI shows multiple ring enhancing lesions with perilesional edema involving bilateral cerebral hemispheres and corpus callosum. MRS shows elavated Choline,reduced NAA and lactate peak.



RESULTS:

Sixty two patients (males=31; females=31) were evaluated in this study conducted at Alluri SitaRamaraju Academy of Medical Sciences, Eluru from Nov 2015 to Oct 2017 over a period of 2 years . MRI along with MRS was performed using 1.5T clinical scanner (Avanto-SQ Engine; Siemens, Erlangen, Germany) in patients ranging from ages of 5-78 years.

Incidence of Various Ring Enhancing Lesions

Lesions	No. of Cases
Neurocysticercosis	13
Tuberculoma	08
Abscess	09
Metastasis	06
Demyelination	01
Pilocytic Astrocytoma	02
Haemangioblastoma	02
Lymphoma	01
Glioblastoma Multiformae	20
Total	62

Comparision Of Incidence Of Neoplastic And Non-Neoplastic Lesions

NEOPLASTIC		NON-NEOPLASTIC	
GBM	20	Neurocysticercosis	13
METASTASIS	6	Abscess	9
PILOCYTIC ASTROCYTOMA	2	Tuberculoma	8
HEMANGIOBLASTOMA	2	Demyelination	1
LYMPHOMA	1		
TOTAL	32	TOTAL	30

Age Wise Distribution of Various Ring Enhancing Lesions

Age (In Years)	No. of Cases
0-10	03
11-20	06
21-30	09
31-40	07
41-50	11
51-60	13
> 60	13

DISCUSSION & CONCLUSION:

Magnetic resonance imaging is a noninvasive, multiplanar and highly accurate method with better inherent contrast that demonstrates the lesion accurately. MRI provides an accurate assessment of the brain changes in various ring enhancing lesions, for accurate diagnosis and introduction of immediate treatment. Sixty two patients were evaluated, whose age group ranged from 5 to 78years. The highest incidence of REL's were found in 51-60 years and >60 years age group. Headache was the most common presenting complaint in 84 % of cases. Glioblastoma multiformae (32%) was the most common pathology followed by NCC (21%), Abscess (15%), metastasis (10%), Pilocytic Astrocytoma (3%), Haemangioblastoma(3%) and Demyelination (2%). Tuberculomas were seen as conglomerate lesions which were iso to hypointense on both T1 and T2. On T1 weighted images they showed iso to hyperintense ring which was seen in 4 cases in our study. All our cases presented with ring like enhancement. MRS showed a Lipid peak in all cases and it plays an important role in identification of tuberculomas from other infective granulomas. All cases of neurocysticercosis presented with multiple

lesions. Scolex was identified in 8 cases using CISS 3D sequence. MRS showed lactate peak. All lesions were hypo to isointense on T1 weighted images and hyperintense on T2. Intense ring enhancement with surrounding perilesional edema was seen in all cases suggestive of active lesions. Single abscess was found in all cases. All were hypointense on T1 weighted images and hyperintense on T2 weighted images. They showed complete diffusion restriction and MRS showed Lactate peak in all 9 cases suggesting anaerobic glycolysis. Multiple lesions were identified in all six cases of metastasis. All cases showed high Cho / Cr and Cho / NAA levels. Primary was identified in three cases in breast, lung and prostrate. Thick, irregular type of ring enhancement was noted after contrast administration. All cases of glioblastoma multiformae were heterogenous on both T1WI and T2WI, predominantly hypointense on T1 weighted images and hyperintense on T2 weighted images. Areas of necrosis seen as hyperintensity on T2 weighted images. Areas of blooming on gradient imaging suggestive of haemorrage in the tumor seen in 11 cases. All cases showed few areas of restriced diffusion on DWI suggesting hypercellularity. All cases showed thick, irregular-enhancing margins and a central necrotic core. All lesions were surrounded by intense perilesional oedema. MR spectroscopy showed elevated choline, reduced NAA and lipid peak in all cases. One case of lymphoma showed multiple lesions involving bilateral cerebral hemispheres including corpus callosum which were iso to hypointense to grey matter on T1 weighted images and hyperintense on T2 weighted images. Most of the lesions showed restricted diffusion on DWI. On post contrast imaging peripheral ring enhancement of the lesions noted with central non enhancing area representing necrosis. MR spectroscopy showed elevated choline, reduced NAA and lactate peak. She was a known case of HIV/AIDS with leucopenia. Both cases of pilocytic astrocytomas were less than 13years of age. In both cases lesion was located in cerebellar hemisphere. Lesion was well defined with cystic and solid components. Mural nodule was hypointense on T1WI and hyperintense on T2WI with cyst content as fluid intensity. On post contrast imaging mural nodule was intensely enhanced with ring like enhancement of the cyst wall.

MRI is the most sensitive modality in the characterization of intracranial ring enhancing lesions – RELs. It shows characteristic imaging findings which helps in differentiating the various RELs. Pattern of signal intensity on T2 and FLAIR, DWI and MRS help to differentiate between benign and malignant lesions. CISS 3D and MRS are to be routinely used in evaluation of ring enhancing lesions. MRI plays a critical role in patient management by suggesting the correct diagnosis based on characteristic imaging findings.

MRS helps in characterization of various ring enhancing lesions. However no lesion can be diagnosed based on the findings of MRS as the sole criteria.

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