Original Research Article

Ring Enhancing Lesions of Brain on MRI in Correlation with MR Spectroscopy

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Abstract

Background and Purpose: This study is intended to study the characteristic imaging findings in various ring enhancing lesions which help in their characterization. A wide variety of aetiologies may present as multiple cerebral ring enhancing lesions. These can be caused by a variety of infectious, neoplastic, inflammatory, or vascular diseases. The aim of the study is differentiating neoplastic & non neoplastic brain lesions using conventional and advanced MR imaging techniques. **Methods:** We studied MRI brain scans of 60 patients who were being evaluated for specific neurological symptoms over a period of 3 months (15-09-2021 TO 15-12-2021) who presented to radiology department. **Results:** Most common lesion seen is Neurocysticercosis (50%) followed by tuberculoma (30%), abscess (10%) & metastasis (10%). 21-30 years is the most common age group involved (30% of cases) and seizures is the most common presenting complaint (60%). Pattern of signal intensity on T2 and FLAIR, Diffusion weighted imaging & MR spectroscopy helps us to differentiate benign from malignant lesions. **Conclusion:** The most sensitive modality useful in the characterization of intracranial ring enhancing lesions is MRI. Most common feature noted in most of the lesions is irregular type of ring enhancement.MRS plays an important role in characterizing various ring enhancing lesions. MR spectroscopy is a most potent tool for making differential diagnosis between brain abscesses and lesions which are non-infectious such as primary brain tumour, lymphoma, brain metastasis, and tuberculoma.

Keywords: Ring enhancing lesions, MRI, MR Spectroscopy.

Introduction

One of the most commonly seen abnormalities on neuroimaging are multiple ring-enhancing lesions of the brain These can be caused by a variety of infectious, neoplastic, inflammatory, or vascular diseases. Differentiating non-neoplastic from neoplastic lesions is more important because a misdiagnosis may lead to unnecessary operative management such as neurosurgery, and it may lead to exposure to toxic chemotherapy or harmful brain irradiation. A wide variety of etiologies may present as multiple cerebral ring enhancing lesions[1,2]. On neuroimaging, they usually appear as mass lesions which are hypodense or iso dense on non-contrast computed tomography studies. After administration of contrast, enhancement in the region of hypodensity appears as ring or a homogeneous disk-like. The lesions which are enhancing are of varying sizes and are usually surrounded by peri focal vasogenic edema.Typically, the ring-enhancing lesions are most commonly located at the junction of the Gray and white matter, but they can be located in the subcortical area, deep in the brain parenchyma or may even be superficial[3].

MR spectroscopy is a most potent tool for making differential diagnosis between brain abscesses and lesions which are non-infectious such as primary brain tumour, lymphoma, brain metastasis, and tuberculoma. Magnetic resonance spectroscopy (MRS) provides information about the possible extent and nature of changes on routine MRI scan by analysing the presence and/or ratio of tissue metabolites such as NAA, creatine, choline, and lactate etc. Longitudinal studies have shown that MRS is useful in monitoring progression of disease and to study effects of treatment. MR spectroscopy also has a useful role in prognostic implication[4]

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Aims & Objectives of the Study

- To differentiate brain lesions into neoplastic & non neoplastic using conventional and advanced MR imaging techniques.
- To study & interpret the specific imaging findings of different ring enhancing lesions on MRI.
- To make correct differential diagnosis of the various ring enhancing lesions visualised on conventional MRI.
- To study the usefulness & role of MR spectroscopy in evaluating various ring enhancing lesions in the brain using single voxel proton MR spectroscopy.

Materials & Methods

Source of Data

Data for the study was collected from patients attending/referred to the department of radiodiagnosis of Konaseema institute of medical sciences & research foundation, Amalapuram who were being evaluated for specific neurological symptoms.

Method of Collection of Data

A prospective study was conducted over a period of 3 months on minimum 60 patients with clinically suspected cerebral parenchymal lesions.

Inclusion Criteria

The study includes

 All suspected cerebral ring enhancing lesions detected on MR studies were taken up for MR Spectroscopy before administration of contrast.

 All patients with incidentally diagnosed ring-enhancing lesion by CT.

 All age groups patients are included in the study irrespective of their gender.

Exclusion Criteria

The study will exclude

 Patient having history of claustrophobia.

 Patients with past history of allergic reactions to contrast.

 Patient who had a history of insertion of metallic implants, cardiac pacemakers and patients with metallic foreign body.

 Patients with deranged renal functions.

Equipment and Technique Used

The MRI scan was performed on PHILIPS ACHIEVA with a magnetic field strength of 1.5 T.

Sequences

Conventional SE sequences, T1, T2 AXIAL & FLAIR: Coronal T2; Sagittal T1; Post contrast axial, coronal and sagittal; DWI; T2 GRE single voxel spectroscopy was performed at TE of 144. The voxel is positioned on the lesion in such a way that it covers the maximum area of the lesion in a single voxel. We used T1 post contrast sequence as localization sequence with 5 mm thickness.

Special sequences such as CISS 3D, SWI were used as and when required.

Statistical test used

Statistical analysis was performed using percentages and proportions.

Results

Table 1:Incidence of various ring enhancing lesions

Lesion	No of cases
Neurocysticercosis	30
Tuberculoma	18
Abscess	6
Metastasis	6

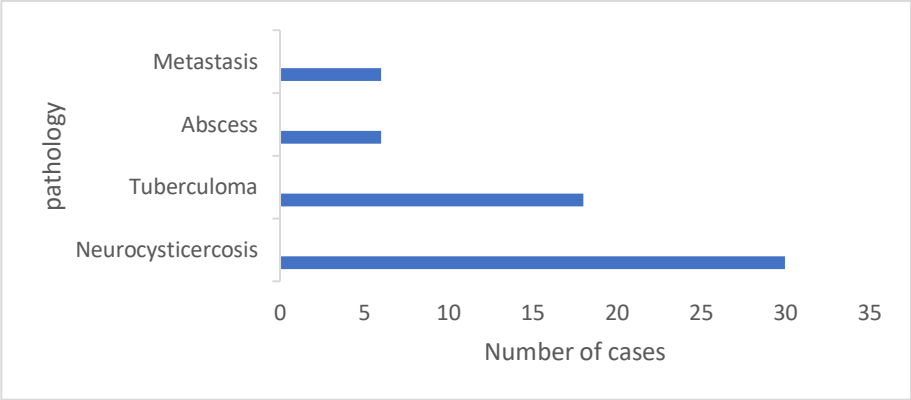


Fig 1: Incidence of various pathologies presenting as ring enhancing lesions

Table 2:Age wise distribution of various ring enhancing lesions.

Age in years	No of cases
0-10	6
11-20	12
21-30	18
31-40	12
41-50	6
51-60	3
>60	3

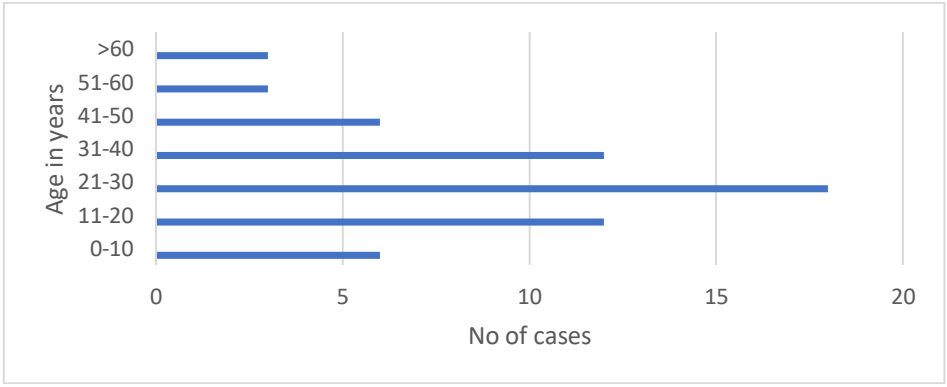


Fig 2:Age wise distribution of various ring enhancing lesions.

Table 3:Number of ring enhancing lesions in a patient

Number	Number of cases
1	24
2-4	24
>4	12

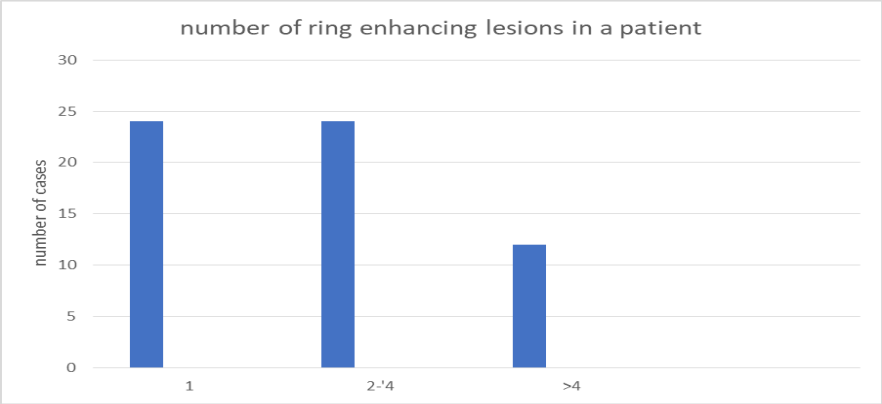


Table 4:DWI in ring enhancing lesions

Diffusion	Number of cases
Showing restriction	36
Showing no restriction	24

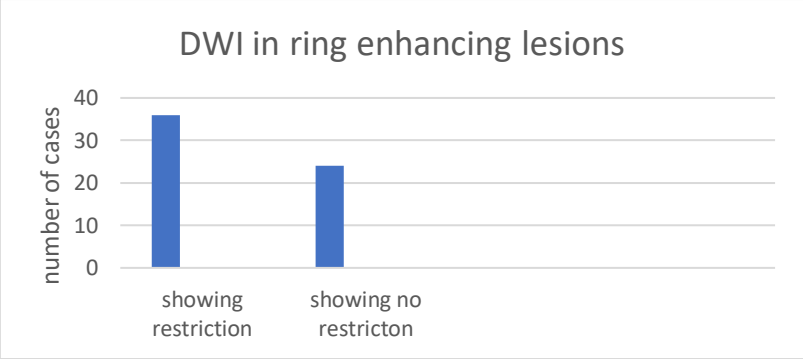
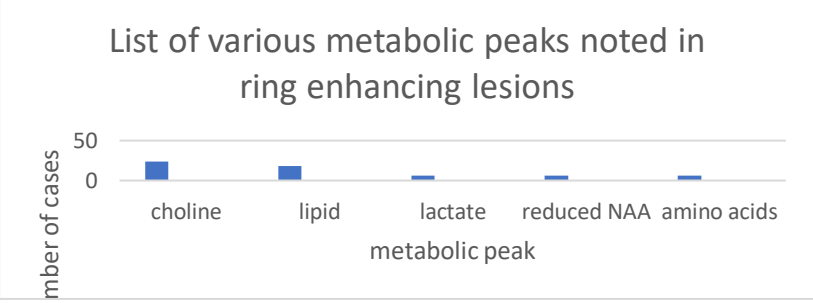
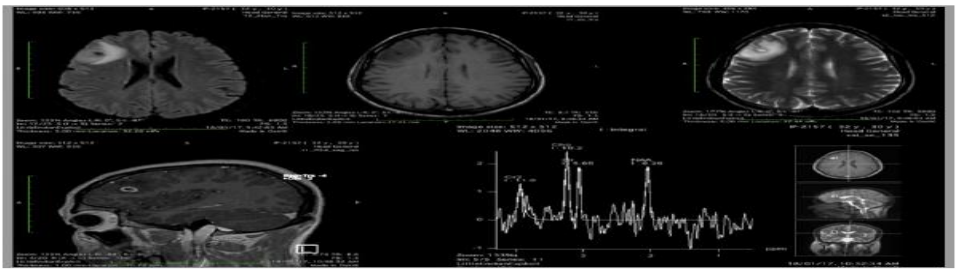


Table 5:List of various metabolic peaks noted in various ring enhancing lesions

Metabolic peak	Number of cases
Lipid	18
Lactate	6
Choline	24
Reduced NAA	6
Amino acids	6

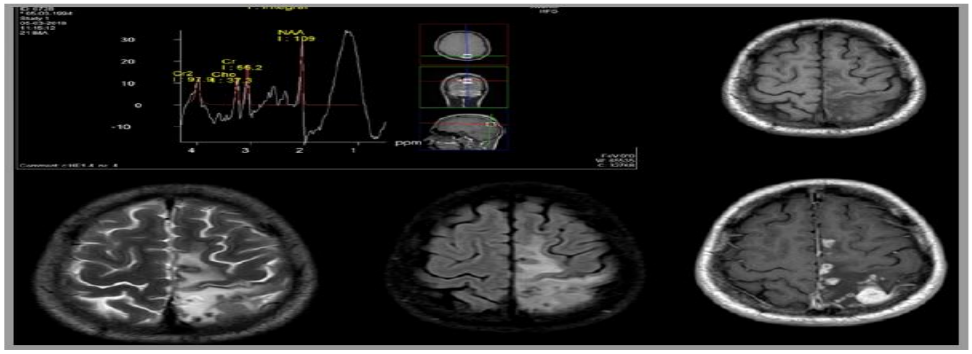


Case of Neurocysticercosis



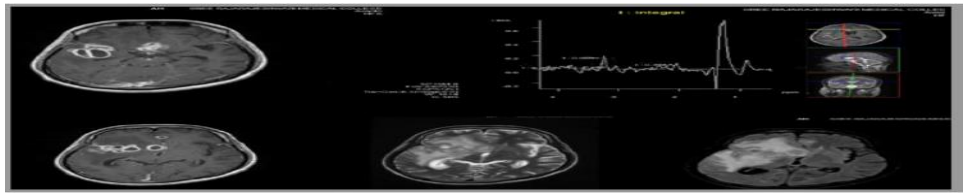
A well-defined, solitary ring enhancing lesion with perilesional oedema in right frontal lobe showing choline peak- suggestive of NCC.

Case of Tuberculoma:



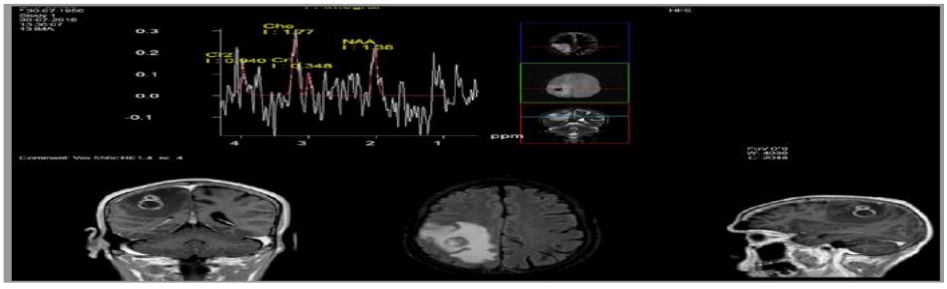
Multiple well defined ring enhancing lesions with intense perilesional edema showing lipid lactate peak, suggestive of tuberculoma.

Case of ABCESS



Multiple, well defined ring enhancing lesions which show restricted diffusion and significant perilesionaledema, showing lipid peak and reduced NAA- suggestive of Tubercular abscess.

Case of Metastasis



Two well defined ring enhancing lesions showing diffusion restriction and spectroscopy showing high choline levels –suggestive of metastasis in a known case of Ca lung

Discussion

Magnetic resonance imaging has the advantage of being multiplanar (as imaging is done in all axes), non-invasive and most accurate method with good inherent contrast that accurately demonstrates the lesion. Sixty patients were evaluated, whose age group ranged from 4 to 70 years. The highest incidence of ring enhancing lesions were found in the age group of 21-30 years accounting for 30% of cases and least incidence among them was seen in age group of 51-60 years accounting for 5 % of cases.Sixty patients were evaluated of which 36 (60 %) were males and 24 (40 %) were females.Seizures are the most common presenting complaint in 60 % of cases. Headache, fever and vomiting were the other presenting complaints.

Pathologies

Out of the 60 patients who were studied, NCC (50%) is the most seen pathology followed by tuberculomas (30 %), Abscesses (10%) & metastasis (10%). In developing countries, most of these lesions are caused by Neurocysticercosis or tuberculosis & it is difficult to make

specific differential diagnoses because the imaging features for diagnosis & clinical findings are similar. These disease patterns are common in areas which are endemic and may be seen to coexist in the same patient[5].These findings are correlated in our study conducted in a developing country.Sixty patients were evaluated – Out of them 24 (40%) presented with a single lesion. 2-4 lesions were noted in 24 (40%) of cases and > 4 RELs were seen in 12 (20%) of cases. Sixty patients were evaluated - 36 (60%) of patients show diffusion restricting lesions (partial/complete) and 24 (40%) of cases shows no diffusion restriction.

Mr Spectroscopy

Out of the sixty patients evaluated, choline peak was observed in 24 cases, Lipid in 18 cases, Lactate in 6 cases, reduced NAA peak in 6 cases and amino acids in 6 cases. MRS is used as complementary to MRI which is non invasive method for characterisation of tissue. MRI uses signals from H+ protons to produce anatomic images whereas Spectroscopy uses this information to determine the concentration of various brain metabolites such as N-acetyl aspartate (NAA), choline (Cho), creatine (Cr), and lactate in the tissue examined.MRS of brain tuberculomas commonly detects peaks of lipids which is attributable to large lipid fractions in tuberculosis bacillus. It also shows increased choline levels and decreased N acetyl aspartate and creatine levels. The choline/ creatine ratio was more than 1 in all tuberculomas but not in NCC.In our study, MRS played a valuable role in making appropriate diagnosis in case of dilemma.

Neurocysticercosis

Choline peak & reduced NAA peak are most commonly seen on MR spectroscopy. Gradient echo imaging played a significant role in identifying calcified lesions All of these lesions were hypo to isointense on T1WI and few of them were hyper intense on T2. Intense ring like enhancement with varying surrounding perilesional oedema was seen in all cases suggestive of active lesions. Parenchymal cysticercosis is better identified on MRI compared to CT in our study as compared to the study done by Suss Ra et al[8]

Cho / Cr ratio was less than 1.1 in all NCC and it is more than 1.2 in all tuberculomas which was similar to the study performed by Kumar et al and Jayasunder et al[9,10]

Tuberculoma

On T1weighted images they show iso to hyperintense ring which was seen in 12 cases in our study. Tae Kyoung Kim et al showed that on T1-weighted images, the granulomas showed a slightly hyperintense rim. On T2WI, the entire portion of the granuloma appeared slightly heterogeneous which shows iso or hypointensity with small markedly hypointense foci. On postcontrast study, single or multiple conglomerate ring enhancements are seen within a tuberculoma Jayasundar R et al concluded that presence of lipid can also be used for differentiating tuberculomas from both nonspecific IG and NCC [6,7] Pre-contrast, the magnetization transfer MRI helps in assessing the disease load in patients with CNS tuberculosis. A higher number of tuberculomas is seen on the magnetization transfer magnetic resonance images compared with routine spin echo images. Magnetization transfer MRI also found to be effective in differentiation of tuberculomas from cysticercus granuloma.

Abscess

Out of the 60 patients, abscess were found in 6 cases – 10 % (males =3; females = 3).On MRI central part of the lesion was T1 hypointense and T2 mildly hyperintense with no suppression on FLAIR sequence. Peripheral ring enhancement, with hypointense wall on T1 & T2 was seen.

Metastasis

Out of the 60 patients, 6 cases were metastasis (males = 3; females =3). Multiple lesions were identified in all of the 6 cases we studied. All the cases showed high Cho / Cr and Cho / NAA levels. All cases were iso to hyperintense on T1, hyperintense on T2 & showing inversion on FLAIR suggestive of cystic metastasis. Thick, irregular type of ring enhancement was noted after contrast administration. Our findings were similar to the study conducted by Vieth RG et al[11]Common tumors that metastasize to the brain include those of lung cancer, malignant melanoma, renal cell carcinoma, breast cancer, and colorectal carcinoma[12]

Conclusion

The most sensitive modality useful in the characterization of intracranial ring enhancing lesions is MRI. Most common feature noted in most of the lesions is irregular type of ring enhancement.

Most common lesion seen is Neurocysticercosis (50%) followed by tuberculoma (30%), abscess (10%) & metastasis (10%). 21-30 years is the most common age group involved (30% of cases) and seizures is the most common presenting complaint (60%). Pattern of signal intensity on T2 and FLAIR, Diffusion weighted imaging & MR spectroscopy helps us to differentiate benign from malignant lesions.

Hypointense on T2WI showing partial or complete restriction on diffusion weighted images & lipid peak on MR spectroscopy favours towards tuberculoma. Hyperintense on T2WI with no evidence of diffusion restriction & presence of scolex on 3D CISS sequence suggests NCC. Abscesses show a hypointense rim on T2 with complete diffusion restriction. Lactate and Amino Acid peak is usually seen on MR spectroscopy.Metastases are well defined hyperintense lesions on T2 which show high choline peak on MRS.

MRS plays an important role in characterizing various types of ring enhancing lesions.

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Conflict of Interest: Nil

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