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# A CROSSECTIONAL STUDY: ROLE OF MRI IN EVALUATION OF INTRACRANIAL RING ENHANCING LESIONS IN CORRELATION WITH MR SPECTROSCOPY

**DR.AKSHITHA SINGH [1], DR.BIJENDAR KUMAR[2] DR.NISHA AURORA[3]**

Post Graduate Student[1], Associate Professor [2] Professor [2]

Department of Radiodiagnosis, NIMS&R, Jaipur

**Corresponding Author: Dr. AKSHITHA SINGH, Post Graduate Student, Department of Radiodiagnosis, NIMS&R, Jaipur**

**Email ID:akshita@gmail.com**

**Abstract**:

**Introduction**: In the field of neuroimaging, the predominant anomaly observed consists of multiple ring-enhancing brain lesions. The objective of this investigation was to delineate and categorize the imaging manifestations associated with diverse ring-enhancing cerebral lesions.

**Material and Methods:** 44 patients (Males=28; Females=16) were evaluated in this study conducted at NIMS Hospital over a period of 1 years. MRI along with MRS was performed in patients ranging from ages of 7-66 years.

**Results:** A total 44 patients presented with various ring enhancing lesions. 28(64%) were males and 16 (36%) were females. 14(32%) were noted on the right side, 12(27%) were noted on the left side, Seizures are the most common presenting complaint in 43% of cases (table-2). 14 (32%) of them presented with a single lesion. Majority 30 (68%) of them showed RELs < 2cm. Evaluated spectroscopy was possible only 36 cases and was not performed in 6 cases because of presence of the lesion close to the bone. Choline peak was observed in 12 cases, Lipid in 10 cases, Lactate in 9 cases, reduced NAA peak in 3 cases and amino acids in 2 cases.

**Conclusion**: The most sensitive modality which can characterize the intracranial ring enhancing lesions RELs is MRI's. Based on characteristic imaging findings, MRI plays a pivotal role in patient management by suggesting the correct diagnosis.

**Keywords:** Magnetic Resonance Imaging, ring-enhancing, lesions, MR Spectrosocpy

## INTRODUCTION:

Multiple ring-enhancing lesions, frequently observed as neuroimaging anomalies on computed tomography (CT) and magnetic resonance imaging (MRI), can be attributed to a range of causes, encompassing infections, malignancies, and immune-mediated demyelinating disorders. [1-2]

MRI is particularly beneficial for early detection of diseases, owing to its capacity to distinctly delineate gray and white matter, tumor ischemia/infarct, edema, MS plaques, infection/abscess, and hemorrhage. It also has the ability to distinguish between infectious brain conditions that manifest as ring-enhancing lesions, such as tuberculomas, neurocysticercosis, and pyogenic or fungal abscesses, and non-infectious lesions like primary brain tumors, lymphomas, brain metastases, and tuberculomas. [3]

Magnetic resonance spectroscopy (MRS) serves as a significant adjunct to MRI by offering insights into the potential extent and nature of changes observed in routine MRI scans. It accomplishes this by examining the presence and/or ratio of tissue metabolites like NAA, creatine, choline, and lactate. This data can assist in comprehending the precise characteristics of the tumor and the morphological and physiological alterations taking place in the surrounding brain parenchyma. [3]

The employment of MRS applications with superior signal-to-noise ratio (SNR) and spatial resolution facilitates the identification of functional metabolic alterations, supplying additional data to comprehend the precise characteristics of the tumor. Longitudinal studies have demonstrated that high-resolution MRS (HMRS) is effective in tracking disease progression and the impact of treatments. MRS also carries prognostic significance, offering crucial information for clinical decision-making.

In patients with compromised immunity, multiple ring-enhancing brain lesions are more commonly induced by Toxoplasma gondii infections and CNS lymphoma. On the other hand, in immunocompetent patients, Mycobacterium tuberculosis infection and immune-related demyelinating conditions are prevalent. [4]

In summary, the integration of MRI and MRS constitutes a potent tool for the detection, characterization, and monitoring of multiple ring-enhancing lesions in the brain. This amalgamation of techniques can support the differential diagnosis of these lesions, supplying crucial information for patient management and treatment strategies. [1]

## MATERIAL AND METHODS:

This study was a forward-looking descriptive analysis conducted on patients from the teaching hospital of the National Institute of Medical Sciences and Research in Jaipur. The study included all patients who were referred to the

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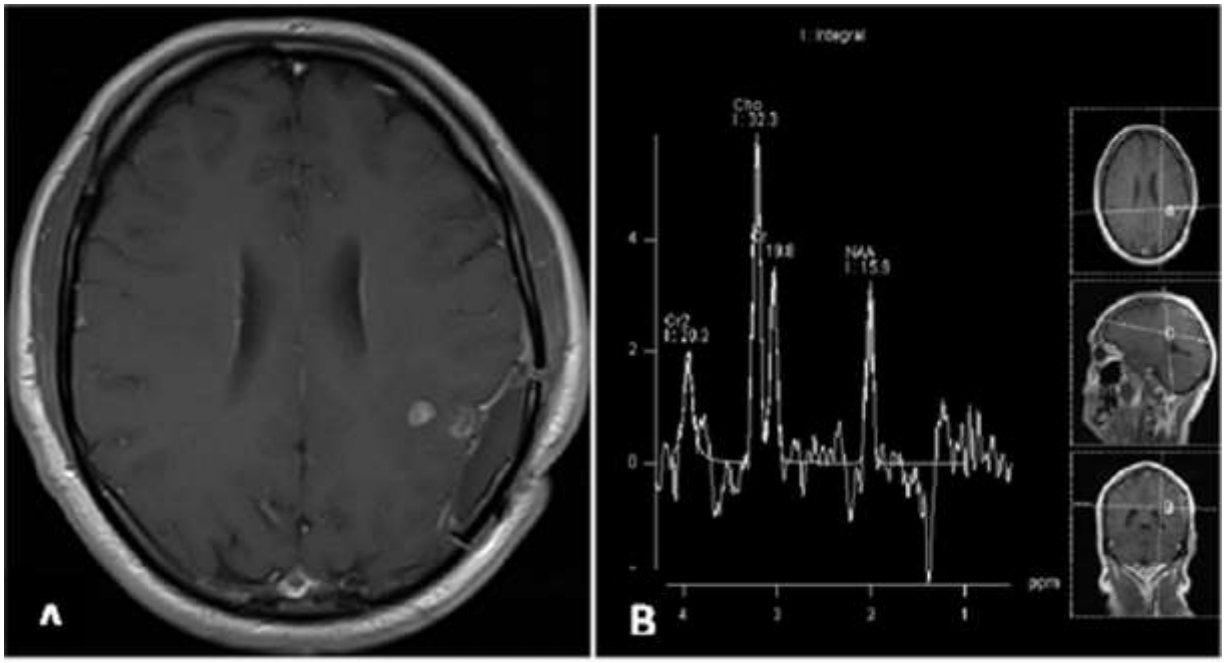
Department of Radiodiagnosis between December 2022 and November 2023, with a clinical suspicion of ring-enhancing brain lesions. The inclusion criteria encompassed all ring-enhancing cerebral lesions detected on contrast MR studies, with no restrictions on age or gender. However, the study excluded patients with a history of claustrophobia, those who had metallic implants or cardiac pacemakers, individuals with metallic foreign bodies, those allergic to gadolinium-based contrast agents, and patients with suboptimal kidney function (GFR <30 ml/min/1.73m2). The MRI scans were conducted using the MR PHILIPS ACHIEVA 1.5T and GE Signa HDxt 1.5 T. The PHILIPS ACHIEVA features an ultra-compact, superconducting, active shielded superconducting magnet with a magnetic field strength of 1.5 T. SENSE coils were utilized for image acquisition.

The criteria for inclusion and exclusion were strictly adhered to. Only those patients who fulfilled these criteria and gave their consent were meticulously interviewed and examined.

Fig. 1. 52 year old male patient with history of left parietal GBM submitted to surgical excision followed by radiotherapy, enhanced parenchymal nodule in post contrast axial T1WI (A) that could be recurrence or radiation necrosis. MRS (B) revealed increase in Choline/NAA ratio




**STATISTICAL ANALYSIS:**

After collecting data, appropriate statistics will be used to analyze the data. In this research, qualitative information was articulated in terms of proportions and percentages, whereas quantitative information was depicted through averages and standard deviations. All statistical analysis will be performed in SPSS (statistical package for social sciences) version 23, Microsoft Word and Microsoft Excel software. The correlation graph is made from the Loggerpro version 3.16.2.

**RESULTS:**

**TABLE 1: AGE DISTRIBUTION OF THE PARTICIPANTS**

| S.No. | Age Group | No. Of cases | Percentage |
|---|---|---|---|
| 1 | 0-10 | 5 | 11.36 |
| 2 | 11-20 | 6 | 13.64 |
| 3 | 21-30 | 8 | 18.18 |
| 4 | 31-40 | 12 | 27.27 |

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**TABLE 1: AGE DISTRIBUTION OF THE PARTICIPANTS**

| | | | |
|---|---|---|---|
| 5 | 41-50 | 6 | 13.64 |
| 6 | 51-60 | 4 | 9.09 |
| 7 | Above 60 | 3 | 6.82 |
| | Total | 44 | 100.00 |

**TABLE 2 SEX DISTRIBUTION OF THE PARTICIPANTS**

| S.No | Sex | No.of cases | Percentage (%) |
|---|---|---|---|
| 1 | Male | 28 | 63.64 |
| 2 | Female | 16 | 36.36 |
| | Total | 44 | 100.00 |

**TABLE 3: SIDE DISTRIBUTION OF PATHOLOGICAL LESION**

| S.No. | Side of pathology | No.of cases | Percentage (%) |
|---|---|---|---|
| 1 | Right | 14 | 31.82 |
| 2 | Left | 12 | 27.27 |
| 3 | Bilateral | 16 | 36.36 |
| 4 | Midline | 2 | 4.55 |
| | Total | 44 | 100.00 |

**TABLE 3: SIDE DISTRIBUTION OF PATHOLOGICAL LESION-1**

| S.No. | Symptom | No.of cases | Percentage (%) |
|---|---|---|---|
| 1 | Seizures | 19 | 43.18 |
| 2 | Headache | 12 | 27.27 |
| 3 | Vomiting | 5 | 11.36 |
| 4 | Weakness | 4 | 9.09 |
| | Fever | 2 | 4.55 |
| | Ataxia | 2 | 4.55 |
| | Total | 44 | |

**TABLE 4: NUMBER OF RING ENHANCING LESIONS IN A PATIENT**

| Number of Lesions Number of Cases | No.of cases | Percentage(%) |
|---|---|---|
| 1 | 14 | 31.82 |
| 2-4 | 22 | 50.00 |
| >4 | 8 | 18.18 |

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**TABLE 4: NUMBER OF RING ENHANCING LESIONS IN A PATIENT**

| | | |
|---|---|---|
| Total Cases | 44 | |
| **Size of Lesion (In Cms)** | | |
| <2 | 30 | 68.18 |
| 2-4 | 6 | 13.64 |
| >4 | 8 | 18.18 |
| | 44 | 100.00 |

**TABLE 5: LIST OF VARIOUS METABOLITE PEAKS NOTED IN VARIOUS ENHANCING LESIONS**

| S.No. | Metabolite Peak | No.of cases | Percentage (%) |
|---|---|---|---|
| 1 | Choline | 12 | 33.33 |
| 2 | Lipid | 10 | 27.78 |
| 3 | Lactate | 9 | 25.00 |
| 4 | Reduced NAA | 3 | 8.33 |
| 5 | Amino Acids | 2 | 5.56 |
| | | 36 | 100.00 |

A total 44 patients presented with various ring enhancing lesions.Tuberculomas (40%) was the most common pathology followed by NCC (30%), Abscesses (10%), metastasis (10%), primary brain tumour (4%) and toxoplasmosis (6%).

The highest incidence of REL's were found in 21-30 years age group accounting for 10 cases and least was seen in age group of >60 years constituting 5%. 28(64%) were males and 16 (36%) were females. 14(32%) were noted on the right side, 12(27%) were noted on the left side, Seizures are the most common presenting complaint in 43% of cases (table-2). 14 (32%) of them presented with a single lesion. Majority 30 (68%) of them showed RELs < 2cm. Evaluated spectroscopy was possible only 36 cases and was not performed in 6 cases because of presence of the lesion close to the bone. Choline peak was observed in 12 cases, Lipid in 10 cases, Lactate in 9 cases, reduced NAA peak in 3 cases and amino acids in 2 cases.

**CONCLUSION:**

In conclusion, MRI stands as the most sensitive technique for characterizing intracranial ring-enhancing lesions (RELs). To distinguish between benign and malignant lesions, factors such as T2 hypointensity, partial or complete restriction on DWI images, and lipid peak on MRS, along with signal intensity patterns on T2, FLAIR, DWI, and MRS, are more indicative of tuberculoma. NCC is suggested by T2 hyperintensity without diffusion restriction and the presence of a scolex on Balanced FFE/FIESTA. Abscesses exhibit a hypointense rim on T2 with complete diffusion restriction, and MRS reveals lactate and amino acids. As a non-invasive and non-ionizing imaging modality, MRI serves as an ideal choice for assessing these lesions.

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