

# Evaluation of Intracranial Ring Enhancing Lesions by MRI and MR Spectroscopy

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**Abstract:** *This aim of the study was to evaluate the diagnostic advantage of MRI and MR spectroscopy in Intracranial Ring Enhancing Lesions. Routine MR imaging of the brain is very sensitive in the identification of ring-enhancing lesions, but it lags some specificity. MR spectroscopy is critical for distinguishing brain abscesses from noninfectious lesions such as primary brain tumours, lymphomas, and metastases. Results – Tuberculomas (48%) were the most common disease among the 100 patients investigated, followed by NCC (31%), Abscesses (9%), Metastasis (8%), and Primary brain tumour (4%).*

**Keywords:** Tuberculoma, MRI, Metastasis, Glioblastoma, Abscess, Neurocysticercosis

## 1. Introduction

Ring enhancing intracranial lesions are considered as a common and quite puzzling diagnostic dilemma.<sup>1</sup> CT & MRI are two advanced, extensively utilised new techniques for detecting these lesions.<sup>2</sup> These lesions may present as solitary or multiple on a brain MRI and are distinguish by a contrast-enhancing hallow with a non-enhancing center.<sup>1</sup> Multiple cerebral ring-enhancing lesions can be caused by viral, neoplastic, inflammatory, or vascular diseases. Numerous primary as well as brain metastases, can manifest as Ring Enhancing Lesions. Numerous non-neoplastic illnesses, such as tuberculosis, cysticercosis, demyelinating disorders, pyogenic abscess, toxoplasmosis, fungal infections, Sarcoidosis, Behcet disease, radiation encephalopathy, as well as certain vasculitis disorders, can mimic brain neoplasm. They present clinically as recurrent seizures, vision impairment, localised neurological deficits, and increased intracranial pressure (headache, vomiting, & papilledema).

Routine MR imaging of the brain is very sensitive in the identification of ring-enhancing lesions, but it lags some specificity. MR spectroscopy is critical for distinguishing brain abscesses from noninfectious lesions such as primary brain tumours, lymphomas, and metastases. By measuring the presence and/or ratio of tissue metabolites such as NAA, creatinine, choline, and lactate, MRS assists in determining the likely extent and nature of changes detected on regular MRI scans. The use of a quicker MRS with a greater signal-to-noise ratio (SNR) and spatial resolution reveals functional metabolic alterations and provides additional information about the tumor's exact nature & alterations in the brain parenchyma. Its utility in monitoring disease development, therapeutic effects, and prognostic implications has been demonstrated in longitudinal investigations.<sup>[3]</sup> This study was done to evaluate the diagnostic advantage of MRI and MR spectroscopy in Intracranial Ring Enhancing Lesions.

## 2. Materials and Methods

It was a prospective Observational study conducted on 100 patients referred to the Department of Radiodiagnosis, Narayan Medical College and Hospital Sasaram, Bihar with clinically suspected intracranial lesion over a period of 24 months (December 2019 to nov 2021).

**Inclusion Criteria:** This study included all the cases irrespective of their age and sex (after obtaining informed consent) with:

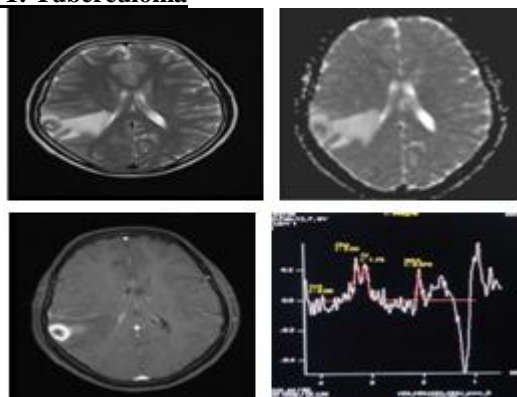
- Intracranial ring enhancing lesions detected on contrast MR studies.
- Intracranial Ring Enhancing Lesion detected by CT.

**Exclusion Criteria:** The following cases were excluded from the study:

- Patients with history of claustrophobia.
- Patients having cardiac pacemakers, metallic implants and other metallic foreign bodies.
- Patients contraindicated for contrast.

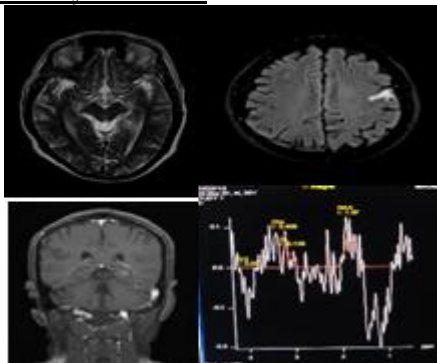
**Machine:** MRI scanning was done on all the selected patients by 1.5 Tesla MRI MagnetomEssenza Siemens System.

### Case 1: Tuberculoma



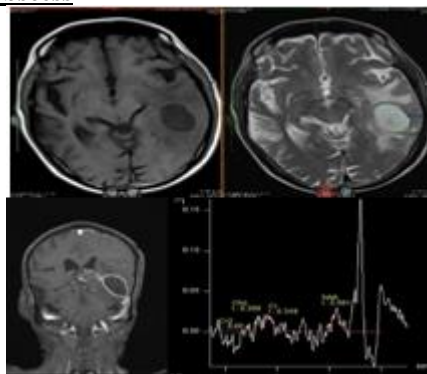
Thick-walled ring enhancing lesion in right temporal lobe having central T2 hyperintense dot and surrounding edema. The lesion hypointense on T1, heterogenous intensity on T2 and FLAIR and shows diffusion restriction. MRS shows lipid lactate peaks S/O Tuberculoma.

**Case 2: Neurocysticercosis.**



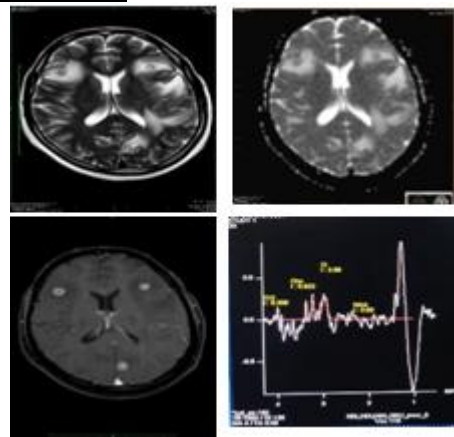
Left parietal lobe and temporal lobe shows cystic lesion, each with a central hyperintense foci with mild surrounding edema, on post contrast images lesion shows ring enhancement. MRS shows amino acid, lactate peak and decreased NAA. F/S/O Neurocysticercosis.

**Case 3: Abscess**



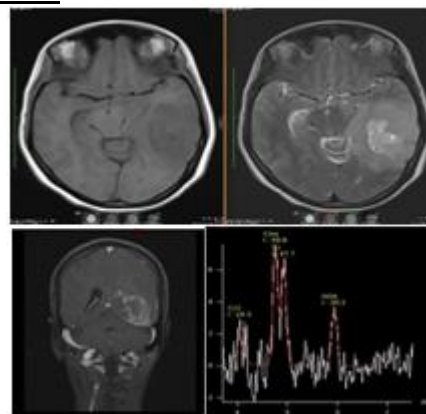
Left temporal lobe shows T1 hypointense, T2 hyperintense lesion with hypointense rim showing diffusion restriction and perilesional edema. Lesion shows ring enhancement on post contrast study. Lesion also shows communication with ventricle with ependymal enhancement. MRS shows lipid, lactate, and succinate peaks and reduced NAA, creatine and choline. S/O abscess with ventriculitis.

**Case 4: Metastasis**



In the follow up operated case of Ca breast multiple nodular and few irregular rings enhancing lesion is seen throughout the cerebral and cerebellar parenchyma and also few in brain stem, also few lesions show blooming on GRE, s/o Internal Hemorrhage. The lesions are associated with disproportionate peri-lesional edema. MRS shows absent NAA – S/O metastasis.

**CASE 5 GBM**



Left temporal lobe shows an intra-axial ill defined heterogenous irregular ring enhancing mass lesion with necrosis, bleed and mass effect in form of contralateral midline shift and descending trans-tentorial herniation. Mas shows restriction on DWI. MRS shows elevated choline with raised choline / NAA ratio S/O Glioblastoma Multiforme.

**3. Results**

**Table 1: Sex Wise Distribution of Different Ring Enhancing Lesions**

Pathology	Male		Female		Total
	Number	Percentage	Number	Percentage	
Tuberculoma	27	27%	21	21%	48
Neurocysticercosis	16	16%	15	15%	31
Brain Abscess	9	9%	0	0%	9
Metastasis	3	3%	5	5%	8
Glioblastoma	0	0%	1	1%	1
Dysembryo plastic, Neuroepithelial tumour	1	1%	0	0%	1
Craniopharyngioma	1	1%	0	0%	1
Recurrence of pituitary macroadenoma	1	1%	0	0%	1

Out of 100 patients who were evaluated, Tuberculoma 48%, Neurocysticercosis 31%, Brain Abscess 9%, Metastasis 8%, Primary CNS Tumour 4% [Glioblastoma 1%, Dysembryoplastic Neuroepithelial tumor 1%, Craniopharyngioma 1% and Recurrence 1% of Pituitary Macroadenoma] respectively.

**Table 2:** Diffusion in Ring Enhancing Lesions

Diffusion	Number of cases	Percentage
Showing Restriction	41	41%
Showing No Restriction	59	59%

100 patients were evaluated -59 (59%) of patients show no diffusion restriction and 41(41%) of cases show diffusion restricting lesions.

**Table 3:** List of Various Metabolite Peaks Noted in Various Enhancing Lesions

Metabolite Peak	Number of cases
Choline	56
Lipid	54
Lactate	50
Reduced NAA	34
Amino Acids	8

Choline peak was found in 56 cases, lipid in 54 cases, Lactate in 50 cases, reduced NAA peak in 34 cases, & amino acids peak in 8 cases.

#### 4. Discussion

This study was done in the department of Radiodiagnosis & imaging of Narayan Medical College and Hospital, Sasarm, Bihar over 100 patients. By studying the MR appearances in many Ring enhancing lesions of the brain following pathologies were diagnosed:

**Tuberculoma:** Tuberculomas were detected in 48 (48%) of the 100 patients tested. Among the 48 patients (27 males and 21 girls), They manifest as conglomerate lesions that are both hypointense on T1 & T2. They exhibit an iso to hyperintense Ring on T1 contrast images. They may exhibit partial or complete diffusion restriction. Lesions may be enhanced in a nodular or irregular ring-like pattern. MRS revealed a lipid peak and is critical for differentiating tuberculomas from other infectious granulomas.

Tae Kyoung Kim, Kee Hyun Chang, Chong Jai Kim, Jin Mo Goo, MyeongCherl Kook, and Moon Hee Han (2015) had shown that on T2-weighted images, the entire granuloma was modestly heterogeneous with small areas of significant hypointensity. Several patients had conglomerate ring enhancements on postcontrast T1-weighted imaging. R. Jayasundar, V.P. Singh, P. Raghunathan, K. Jain, and A.K. Banerji (2019) established that the presence of lipid can be used to distinguish tuberculomas from non-specific IG & NCC.

**Neurocysticercosis:** Neurocysticercosis was observed in 31 (males 16; females 15) of the 100 patients studied; 12 patients presented with single lesions, whereas 19 individuals presented with numerous lesions. Scolex was discovered in eight cases by the use of the CISS 3D

sequencing. MRS analysis reveals a alanine, lactate, succinate peak and a decreased NAA peak. Gradient echo imaging was critical in finding calcified lesions in three cases (3%). On T1 weighted images, all lesions were hypo- to isointense, and 12 instances were hyperintense on T2. 19 of the 12 lesions exhibited FLAIR inversion.

In our investigation, parenchymal cysticercosis was better recognised by MRI than CT, in comparison to Suss Ra et al study. .s

The characteristics of parenchymal types of NCC in our study are comparable to those described by Amaral LL et al (4) Cho / Cr ratios were less than 1.1 in all NCC and greater than 1.2 in all tuberculoma, which is consistent with Kumar et al. and Jayasunder et al.

**Abscess:** Abscesses were discovered in 9 of the 100 patients(9%). All of the instances were larger than 2, and one was larger than 4 cm. All were hypointense on T1 weighted images & hyperintense on T2 weighted images with a surrounding hypointense rim (5 cases). They demonstrated total diffusion restriction, and MRS analysis revealed a lactate peak in all nine cases, implying anaerobic glycolysis involving amino acids such as glutamine in three cases. Holmes et al. described how abscesses appear on MR. We compared our findings to those previously described and differentiated peripheral edoema, central necrosis, as well as the abscess capsule's typical pattern of peripheral enhancement. Our findings were consistent with those of Tsui EY et al.(6), Shukla Dave A et al.(7), and Leuthardt EC et al.

**METASTASIS:** Eight patients (three men and five females) had metastases. In each of the eight cases, several lesions were found. Cho/Cr and Cho/NAA levels were elevated in all instances. All eight instances were hyperintense on T2, with two cases exhibiting FLAIR inversion, indicating cystic metastases. Three cases of primary cancer were detected in the breast, lung, and prostate. Post contrast study shows irregular thick rim enhancement. Our findings corroborated those of Vieth RG et al. (10)

#### 5. Conclusion

- MRI is the most sensitive modality in the characterization of intracranial ring enhancing lesions. It shows characteristic imaging findings which help in differentiating various RELs. The most common ring enhancing lesions seen in developing countries like India are Tuberculoma and NCC.
- MRS helps in characterization of lesions and narrowing down the differentials and thus guiding management.

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