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## A study on CT evaluation of ring enhancing lesions of brain

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### Abstract

**Background:** The two most common differential diagnosis of this lesion in clinical practice include neurocysticercosis (NCC) and tuberculomas. In Indian paediatric patients the most common radiological abnormalities seen in epilepsy is single small enhancing computed tomography lesions. It is difficult to differentiate between tuberculomas and a single cysticercal granulomas.

**Aims & Objectives:** To determine the etiological nature of different diseases, ring enhancing lesions on CT and also compare the CT morphology with pathological diagnosis whenever it is possible.

**Methodology:** It is prospective observational study. This study was carried out in 100 patients seen at the department of radio diagnosis and imaging, Shadan institute of Medical Sciences and research centre, Hyderabad between (Mention study periods). All the patients underwent CSF analysis and CT examination.

**Results:** In the present study, the age of patients in our series was 5 years to 79 years. Maximum cases were seen in age group 21-50 years (60 cases). 20 cases were seen above 50 years and the remaining 20 cases below the age of 20 years. There were 58 males and 42 females. Male to female ratio was 4:3. In the etiological diagnosis, neurocysticercosis (NCC) were 45% (45), 22% (22) were tuberculomas, 12% (12) were metastasis, 11% (11) were brain abscess and 10% (10) were GBM. Single ring was seen in 56 cases (56%), while multiple rings (two or more) seen in 44% (44 cases). 52% patients had size of ring less than 10mm, while 48% cases had ring more than 10mm in size.

**Conclusion:** CT is still the preferred investigation in many centres due to wide availability, lower cost, less time consumption particularly in paediatric patients.

**Keywords:** Computed tomography (CT), tuberculoma, metastasis, neurocysticercosis

### Introduction

Ring enhancing lesions in CT and MRI of the brain can be caused by different pathological conditions. The common lesions being some primary brain tumours, abscess, granuloma, resolving haematoma and infarct. Less common conditions being thrombosed vascular malformation and demyelinating disease such as Multiple Sclerosis. Uncommon causes being thrombosed aneurysm and other primary brain tumours such as primary CNS lymphoma in AIDS etc. With this large list of conditions contributing to intracranial ring enhancing lesions one has to assess the patient clinically as well as distinguish between neoplastic and non-neoplastic nature of the lesion as detected in CT and / or MRI<sup>[1]</sup>.

In this study, an attempt has been made to establish the etiological diagnoses of ring-enhancing lesions of the brain using clinical findings and neuro imaging abnormalities, and by blood and cerebrospinal fluid (CSF) examinations. This is important since they present with diagnostic and therapeutic challenges simultaneously<sup>[2]</sup>.

This study is undertaken with a view to study patients with such lesions on neuroimaging, keeping in mind the diversity in relation to their clinical presentation, etiological factors and methods of investigation and impact of various modes of management.

### Aim of the study

1. To determine the etiological nature of ring enhancing lesions on CT features.
2. To formulate specific features for different disease entities.
3. To compare the CT morphology with pathological diagnosis whenever it is possible.

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**Materials and Methods**

**Design of the study**

This study was carried out in 100 patients seen at the department of radiodiagnosis and imaging, Shadan institute of Medical Sciences and research centre, Hyderabad. All the patients were further investigated to find out etiology, which includes X-ray of chest, skull and CSF analysis. CSF was examined in cases for cell counts, proteins and sugar estimation.

All patients underwent CT examination on a somatom spirit Siemens dual slice helical CT after brief explanation of risks of contrast examination to the patients.

**Inclusion criteria**

All patients underwent a thorough clinical examination, the points noted were duration of illness, type of seizure, any associated illness, based on history and examination, a clinical-etiological diagnosis was made. All the patients were further investigated to find out etiology, which includes X ray of chest, skull and CSF analysis. CSF was examined in cases for cell counts, proteins and sugar estimation.

All patients underwent CT examination on a somatom spirit Siemens dual slice helical CT after brief explanation of risks of contrast examination to the patients.

**Methodology**

routine investigations –HB, TLC, DLC, ESR, urine routine examination, fundus examination, X-ray chest – PA view and lateral view., CSF–cytology, biochemical investigations, AFB, culture and sensitivity, malignant cells.

**Ct scan brain**

**Materials**

- \*whole body CT scanner–soma tom spirit Siemens dual slice helical CT (3<sup>rd</sup> generation)
- \*X ray machine: X ray 500 ma with IITV-Heliophos -D-seimens.
- \*contrast media: Iopamidol 370, omnipaque.
- \*emergency drugs like injections Avil, Decadron, Adrenalin etc., syringes: 2ml, 5ml, 10ml, and 20ml.
- \*defibrillator, pressure injector.

**Technique of examination: CT SCAN**

The usual CT Examination was done by scanning the head in a series of axial slices at 10-12. To the reids base line in all the patients. Sections were also taken in parallel to the reids base line. The scanning was done with 10mm thick slices and 10-12 slices were usually sufficient to visualize the intermediate slices were also scanned. Both plain and contrast enhances scans were done (by giving bolus injection of omnipaque intravenously). CT findings were recorded in all the patients and the following CT findings were studied as under:

- \*location of ring lesions, \*size \*number \* wall thickness \* internal features \* surrounding edema.

**Observations and results**

**Table 1:** Age distribution

| Age   | No of patients | Percentage |
|-------|----------------|------------|
| <20   | 20             | 20%        |
| 21-50 | 60             | 60%        |
| >50   | 20             | 20%        |

**Table 2:** Sex of the Patients

| Sex    | Number | %  |
|--------|--------|----|
| Male   | 58     | 58 |
| Female | 42     | 42 |

**Table 3:** Etiological Diagnosis of the patients

| Etiology           | Number | %   |
|--------------------|--------|-----|
| Neurocysticercosis | 45     | 45% |
| Tuberculomas       | 22     | 22% |
| Metastasis         | 12     | 12% |
| Brain abscess      | 11     | 11% |
| GBM                | 10     | 10% |

The age of patients in our series was 5years to 79 years. Maximum cases were seen in age group 21-50years (60 cases).20 cases were seen above 50 years and the remaining 20 cases below the age of 20 years. There were 58 males and 42 females. Male to female ratio was 4:3.

In the etiological diagnosis, neurocysticercosis (NCC) were 45% (45), 22% (22) were tuberculomas, 12% (12) were metastasis, 11(11%) were brain abscess and 10 (10%) were GBM.

**Table 3:** Etiology of Ring formation

| Etiology of ring formation  | Number | %  |
|-----------------------------|--------|----|
| Single ring                 | 56     | 56 |
| Multiple ring (Two or more) | 44     | 44 |

**Table 4:** Size of the ring

| Size   | Number | %  |
|--------|--------|----|
| <10 mm | 52     | 52 |
| >10mm  | 48     | 48 |

**Etiology depending on number of the rings**

Single ring was seen in 56 cases (56%), while multiple rings (two or more) seen in 44%, (44 cases). 52% patients had size of ring less than 10mm, while 48% cases had ring more than 10mm in size.

**Discussion**

**Neurocysticercosis**

Neurocysticercosis was the most common ring enhancing lesion in our study. In our study, all the patients presented with generalized convulsions alone and convulsions with headache. We found all our cases were parenchymal lesions and 18 patients showed both calcifications and cystic lesion. The other 27 patients (60%) showed only cystic lesions. We found 8 out of18 patients had a central calcification. All our cases were situated I the supratentorial compartment either at gray white matter junction or in cortex, Garg *et al.* [1] have reported a similar distribution of disease. In our study, 29(51.78%) patients had solitary lesions and 16(36.36%) had multiple lesions. Our study consistent with Martinez *et al* reported intraventricular neurocysticercosis in 22% of cases [2].

**Tuberculoma**

In our study male predominance of lesions noted. Males 16 and females 6, 60% of cases were in 6-40 years age group. 63% in parietal region, 60% cases were multiple tuberculomas. Wasay M (2003) [3] reported tuberculomas were multiple in 69%.We found, regular ring in 19(86.5%) cases, irregular ring in 3(13.7%) cases, of the 22 cases, 16

cases (72.7%) had ring size more than 10mm while 6(27.3%) had less than 10mm. In contrast, Kumar *et al* (1995) <sup>4</sup> reported 15 cases of tuberculoma (68.18%) having ring size between 5-10mm. Our study showed the density of tissue within the ring is similar to that of the surrounding brain in 14 cases (64%) and in 4 cases (18%) hyperdense and hypodense in 4 cases. In our series, 7(30%) patients have identifiable focus of pulmonary infection.

### Brain Abscess

In our study, all 11 patients showed low-density with an enhancing ring and surrounding edema and variable mass effect. In our study there were 6 males and 5 females with slight male predominance. 9 patients had thin and uniform thickness of wall of ring lesion. 2 out of 11(18.2%) cases did not have uniform ring thickness. This is in agreement with Mahato *et al.* <sup>[5]</sup> and Sonmez *et al.* <sup>[6]</sup> who reported 40-50% of brain abscess do not have uniform ring thickness. 3 of our patients had evidence of ependymal enhancement on their CT scan indicating ventriculitis. Out of 11 cases our study 4 patients had middle ear infection, 4 had paranasal sinus infection, 1 had congenital heart disease and 2 patients did not have identifiable predisposing factors. 1 case of less than 1cm in size showed decrease in size after 2 weeks of treatment. On follow up scans all revealed decrease in the degree of enhancement of ring and a uniform decrease in edema and mass effect.

### Metastasis

In our study, there were 12 cases out of which 6 were males and 6 were females. All patients were above 35 years of age, youngest was 36 years and eldest was 79 years. Our study correlated with Floeth <sup>[7]</sup>, who reported 76.7% of metastases, 11 out of 12 patients had primary malignancies. Of these 5 had lung primaries (41.6%). 3 had breast primaries (25%), 2 had renal, 1 had cervical carcinoma, 1 patient had unknown primary malignancy. In our series 8 patients presented with headache. Others presented with focal neurological deficit. In our study, in 9 patients, the lesions were seen in the supratentorial region with 3 patients only in infratentorial region. 11 showed multiple lesions and one showed single lesion on enhanced CT scan, 8 patients showed hypodense lesions and 2 had isodense lesion and 2 showed hyperdense lesions. In our study, 8 patients (66.6%) showed thick, irregular ring like enhancement. 8 patients (66.6%) showed evidence of necrosis within the metastatic nodule. 4 patients showed thick regular ring. Patil *et al.* <sup>[8]</sup> reported by CT features alone it would be difficult or impossible to differentiate solitary metastases from primary malignant neoplasm.

### Glioblastoma Multiforme

Glioblastoma is the commonest primary malignant tumour of brain. In our study there were 10 cases 4 were males and 6 were females with slight female predominance. All were histologically proved, all were above 40 years, with equal male and female predominance, all the cases were in supratentorial region, 8 were in frontal region, 2 were in the parietal region. In our series on NECT, 7 cases (70%) showed mixed attenuation, 2 were low attenuation; the other 1 was isodense with brain parenchyma. This correlated with results of Wassey <sup>[3]</sup> who reported that, mixed attenuation as the most frequent presentation was 38.5% to 65.3% incidence, hypodense in 11.8 to 27% isodense in 14.5-

16.8% and hyperdense in 8.5-18% of the cases. On CECT, previous studies detected annular type with central low density as the most frequent pattern seen in 55% of cases, mixed type in 27% and nodular type in 13% of cases <sup>[7]</sup>.

### Conclusion

CT is useful in detecting different characteristics of ring enhancing lesions like size, thickness, number, calcification, perilesional edema, location, mass effect and it is also useful in follow up of patients after treatment. We conclude that NCC is the most common ring enhancing lesion in Hyderabad and Rangareddy district of Telangana. CT findings of solitary ring, size less than 10mm with central eccentric dense foci (scolex) is suggestive of NCC, ring size >10mm, multiple and conglomerate rings with perilesional edema and associated with meningitis suggestive of tuberculomas. Brain abscess showed single ring enhancing region more than 10mm with peripheral rim enhancement with associated ventriculitis, PNS and temporal bone infections. Metastasis showed lesions at grey white matter junction with disproportionate edema. GBM-CT findings irregular dense thick and intense ring enhancing lesions in white matter with perilesional edema and necrosis.

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