

ORIGINAL RESEARCH

Clinical, biochemical and radiological correlation of single ring enhancing CT lesion

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ABSTRACT

Radiographically, tuberculomas are discrete, single or multiple ring-enhancing lesions of the brain surrounded by perilesional edema. On contrast computed tomography imaging, early-stage tuberculoma radiologically consist of low density or isodense lesions, often with edema out of proportion to mass effect and with little encapsulation. Late stage tuberculomas are well encapsulated, isodense or hyperdense, and have peripheral ring enhancement. A detailed history, clinical and laboratory data of these patients at admission and then on daily basis will be recorded as per the Proforma. Details of the patient's history were taken in pretested Proforma at the time of admission and recorded. Various Examination was done like General, Systemic and neurological. In cases with NCC, the symptoms of seizure were present in 6 patients, headache in 2 patients, vomiting in 1, weakness in 2 patients, fever in no cases and others in 1 patient. Tuberculoma, symptoms of seizure were present in 6 patients, headache in 5 patients, vomiting in 1, weakness in 2 patients, fever in 1 and others in 5 patients. Abscess, the symptoms of seizure were present in 4 patients, headache in 4 patients, vomiting in 2, weakness in no patients, fever in 2 cases and others in 5 patients. Toxoplasmosis, the symptoms of seizure were present in 1 patient, headache in 2 patients, vomiting in 1, weakness in 2 patients, fever in 2 cases and others in 2 patients. Neurosyphilis, the symptoms of seizure were present in 1 patient, no patients had headache, vomiting, weakness or fever, with other symptoms in 1 patient Metastasis, symptoms of seizure 1 patient, no cases with headache, vomiting and fever, weakness in 1 patient and other in 1 case. Malignancy, symptoms of seizure were present in 2 patients, headache in 2 patients, vomiting in 1, weakness in 1 patients, fever in no cases and others in 2 patients. CNS lymphoma, symptoms of headache and other in 1 each patient and no other symptoms of vomiting, fever seizures and weakness.

Key words: Single ring enhancing CT lesion, tuberculoma, neurosyphilis

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INTRODUCTION

Most of the parenchymal NCC are asymptomatic and resolve with development of calcifications and are identified incidentally via radiographic imaging performed for other reasons. Symptomatic intraparenchymal cysticerci most commonly present with seizures (focal may be associated with secondary generalization associated with headache and/or any focal neurologic signs based on the location of the lesion. NCC is the most common cause of adult-onset seizures. Extra parenchymal cysticerci are associated with symptoms of elevated intracranial pressure (e.g., headache, nausea, and vomiting) and sometimes with altered mental status. Most of the asymptomatic cystic lesions resolve with development of calcifications.¹

Radiographically, tuberculomas are discrete, single or multiple ring-enhancing lesions of the brain surrounded by perilesional edema. On contrast computed tomography imaging, early-stage tuberculoma radiologically consist of low density or isodense lesions, often with edema out of proportion to mass effect and with little encapsulation. Late stage tuberculomas are well encapsulated, isodense or hyperdense and have peripheral ring enhancement.² On magnetic resonance imaging (MRI), tuberculomas appear hypointense on T1-weighted images and hyperintense on T2-weighted images. With contrast enhancement, there is either ring-shaped or homogeneous disc-shaped enhancement. Differentiating between tuberculomas and neurocysticercosis on CT brain may be difficult.

However, tuberculomas are usually larger in size and multiple. They are more common in posterior fossa unlike cysticercus granuloma which are common at the gray-white junction.

Pyogenic abscess appears as a mass with a continuous capsule, hyperintense and hypointense in T1- and T2-weighted sequences respectively, with regular rim enhancement after gadolinium injection. The necrotic center is hypointense in T1-weighted sequence, hyperintense in T2-weighted sequence, and hyperintense in Diffusion-Weighted magnetic resonance Imaging (DWI). DWI is capable of differentiating ring-enhancing lesions due to brain abscess from neoplastic lesions where abscesses are usually hyperintense on DWI (indicating restricted diffusion, characteristic of viscous materials, such as pus), and neoplastic lesions are hypointense or show variable hyperintensity which is lower than the intensity seen with an abscess.³

Parenchymal fungal and fungal-like abscesses are typically low attenuating, with or without surrounding vasogenic edema on nonenhanced CT images and contrast images shows peripheral rim enhancement. MR images typically show a T1 isointense or T2 hyperintense focus enhancing on T1-weighted contrast-enhanced images with surrounding hyperintense areas corresponding to perilesional edema, on T2-weighted and FLAIR image. These abscesses are generally hyperintense centrally, with high b values, on diffusion-weighted MR images and are hypointense, correlating with central restricted diffusion, on apparent diffusion coefficient maps. Their appearance is difficult to distinguish from that of pyogenic abscesses. CNS cryptococcal infections uniquely present as a intra axial gelatinous pseudocyst. These T2-hyperintense cystic structures are seen in the deep perivascular spaces, typically in the basal ganglia.⁴

METHODOLOGY

INCLUSION CRITERIA

All patients with Contrast Computed Tomography (CT) of brain showing single ring enhancing lesions. Cases of all age groups irrespective of sex

EXCLUSION CRITERIA

All patients who is having multiple lesions on the CT brain.

Patient having history of metallic implants insertion, cardiac pacemakers and metallic foreign body *in situ*.

METHODOLOGY

A detailed history, clinical and laboratory data of these patients at admission and then on daily basis will be recorded as per the Performa. Details of the patient’s history were taken in pretested Proforma at the time of admission and recorded. Various Examination was done like General, Systemic and neurological. At the time of enrollment several tests were undergone by patients such as routine hematological, biochemical, Human Immune Deficiency Virus (HIV), Venereal Disease Research Laboratory (VDRL), X-Ray of

Chest, Urea, Blood sugar level, Electrolytes and Liver function tests. After consent by the respective patient CT brain with single enhancing lesion was considered for enrollment in the study.

EQUIPMENT AND TECHNIQUE USED

The CT scan was performed CT Philips multi slice scanner.

TECHNIQUE OF EXAMINATION

The CT examination was carried out by scanning the head in a series of axial slices at 10-12. To the reids base line in all the patients and sections were taken in parallel to the reids base line. During the scanning, 10-12 slices of 10 mm thick were taken and they are sufficient to visualize the intermediate slices. The plain as well as contrast enhanced scans were recorded in all the patients in order to study the CT finding. The study of CT finding includes such as size, number, and wall thickness, location of ring lesions, internal features and surrounding edema.

STATISTICAL ANALYSIS

Statistical analysis was carried out using Microsoft Excel version 2007. Data were described in terms of mean and standard deviation (\pm SD), frequencies (number of cases). The comparison between two groups of diseases that is infectious and non-infectious were compared in terms of clinical symptoms, neurological features, risk factors and site selection values using Student’s t-test. The values are presented on the basis of the mean and Standard deviations (SD). A P value < 0.05 was considered statistically significant.

RESULTS

Table 1: Correlation between Disease and Clinical Symptoms

Diseases	Seizure	Headache	Vomiting	Weakness	Fever	others
Neurocysticercosis	6	2	1	2	0	1
Tuberculoma	6	5	1	2	1	5
Abscess	4	4	2	0	2	5
Toxoplasmosis	1	2	1	2	2	2
Neurosyphilis	1	0	0	0	0	1
Metastases	1	0	0	1	0	1
Malignancy	2	2	1	1	0	2

CNS Lymphoma	0	1	0	0	0	1
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In cases with NCC, the symptoms of seizure were present in 6 patients, headache in 2 patients, vomiting in 1, weakness in 2 patients, fever in no cases and others in 1 patient. Tuberculoma, symptoms of seizure were present in 6 patients, headache in 5 patients, vomiting in 1, weakness in 2 patients, fever in 1 and others in 5 patients. Abscess, the symptoms of seizure were present in 4 patients, headache in 4 patients, vomiting in 2, weakness in no patients, fever in 2 cases and others in 5 patients. Toxoplasmosis, the symptoms of seizure were present in 1 patient, headache in 2 patients, vomiting in 1, weakness in 2 patients, fever in 2 cases and others in 2 patients. Neurosyphilis, the symptoms of seizure were present in 1 patient, no patients had headache, vomiting, weakness or fever, with other symptoms in 1 patient Metastasis, symptoms of seizure 1 patient, no cases with headache, vomiting and fever, weakness in 1 patient and other in 1 case. Malignancy, symptoms of seizure were present in 2 patients, headache in 2 patients, vomiting in 1, weakness in 1 patients, fever in no cases and others in 2 patients. CNS lymphoma, symptoms of headache and other in 1 each patient and no other symptoms of vomiting, fever seizures and weakness.

Table 2: Correlation between Diseases and Risk Factors

Diseases	Habits	Diet	Primary Malignancy	Known/Active TB	Trauma/Surgery	Seizure Disorder	RVD	Others
Neurocysticercosis	3	1	0	0	0	1	0	2
Tuberculoma	0	1	0	4	0	0	0	0
Abscess	1	2	0	0	1	0	0	1
Toxoplasmosis	0	0	0	0	0	0	2	0
Neurosyphilis	0	0	0	0	0	0	0	0
Metastases	0	0	1	0	0	0	0	0
Malignancy	1	1	0	0	0	0	0	0
CNS Lymphoma	0	0	0	0	0	0	0	0

NCC-In patients with NCC, 3 patients had habits of alcohol and smoking, 1 patient had non vegetarian diet, 1 patient had seizure disorder.

Tuberculoma-In patients with Tuberculoma 1 patient had non vegetarian diet, 4 patients are known cases of active pulmonary tuberculosis.

Abscess-In patients with Abscess, 2 patient had non vegetarian diet, 1 patient had habits of alcohol and smoking, 1 patient had trauma/surgery, 1 had others.

Toxoplasmosis-2 patients have risk factor of RVD. Neurosyphilis-no risk factors in neurosyphilis cases in this study. Metastasis-1 case had risk factor of Primary malignancy.

Malignancy-1 patient had habits of alcohol and smoking, 1 patient had non vegetarian diet. CNS lymphoma-no risk factors in this study.

Table 3: Correlation between Diseases and Neurological Features

Diseases	Pure Motor	Motor Hemideficit with cortical deficits	Cranial nerve	Pure sensory	Higher cerebral Dysfunction
Neurocysticercosis	1	1	0	0	1
Tuberculoma	1	2	0	0	0
Abscess	0	0	1	0	2
Toxoplasmosis	1	1	0	0	0
Neurosyphilis	0	0	0	0	0
Metastases	0	1	0	0	0
Malignancy	0	2	0	0	0
CNS Lymphoma	0	0	0	0	0

NCC-Cases with pure motor defecit are 1, motor hemideficit with cortical defecit 1, with higher cerebral dysfunction in 1 patient.

Tuberculoma-Cases with pure motor defecit are 1, motor hemideficit with cortical defecit 2.

Abscess-cases with cranial nerve involvement in 1 patient and higher cerebral dysfunction in 2 patients.

Toxoplasmosis-Cases with pure motor defecit are 1, motor hemideficit with cortical defecit 1.

Neurosyphilis and CNS lymphoma-In our study no neurological features are present in Neurosyphilis CNS lymphoma.

Metastasis-motor hemideficit with cortical defecit 1. Malignancy-motor hemideficit with cortical defecit 2.

Table 4: Correlation between Diseases and Site Selection

Diseases	Brain parenchyma	Subcortical region	Gray white matter junction	Periventricular region	Meninges
Neurocysticercosis	3	0	3	1	0
Tuberculoma	3	2	0	1	0
Abscess	4	1	0	0	0
Toxoplasmosis	0	2	0	0	0
Neurosyphilis	1	0	0	0	0
Metastases	1	0	0	0	0
Malignancy	1	0	0	0	1
CNS Lymphoma	0	0	0	1	0

NCC-In our study site of lesion is brain parenchyma 3 cases, gray white matter 3 cases and periventricular region 1 case.

Tuberculoma-site of lesion is brain parenchyma 3 cases, subcortical 2 cases and periventricular region 1 case. Abscess-site of lesion is brain parenchyma 4 cases, subcortical 1 case.

Toxoplasmosis-subcortical 2 cases.

Neurosyphilis-site of lesion is brain parenchyma 1 case. Metastasis-site of lesion is brain parenchyma 1 case.

Malignancy-site of lesion is brain parenchyma 1 case and 1 case had meningeal lesion. CNS lymphoma-site of lesion in periventricular region 1 case.

DISCUSSION

In our study, out of 25 patients evaluated neurocysticercosis was seen in 7 cases (male=7 and female=0) showing males were predominantly affected. Out of 7 cases, 2 cases were located in parietal region with significant perilesional edema, 1 case was located in Parietal region with small amount of edema, 1 case was located in frontal region with perilesional edema, 1 case was located in frontal region with calcified granuloma and 1 case was temporal region with perilesional edema. Showing that in most parietal lobe involvement was common and most lesions were associated with perilesional edema.

The common clinical symptom present in neurocysticercosis was seizures (85.71%). and others were headache (28.7%), vomiting (%), weakness (14.28%) and others (14.35%). This study is similar to study was done by Garg RK *et al.*⁵ and reported that incidence of neurocysticercosis was 80% among those presented with seizures with ring enhancing lesions.

From the neuro examination study, it was observed in only 1 case had a pure motor, 1 case had a motor hemideficit with cortical deficits and 1 case had a higher cerebral dysfunction.

In our study, Tuberculoma was the most common single ring enhancing lesion. Out of 25 patients evaluated Tuberculoma was seen in 6 cases (male =3 and female=3). Out of 6 cases, 4 cases were well defined single ring enhancing lesion located in the parietal lobe with edema, 1 case was located in the frontal region with large conglomerate ring enhancing, 1 case was located in the frontal region

and well defined hypodensity with surrounding edema and 1 case was located in the temporal region with edema. Wasay M *et al.*⁶ reported tuberculomas were multiple in 69%. They 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.*⁷ reported 15 cases of tuberculoma (68.18%) having ring size between 5-10mm. The study showed the density of tissue with in 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 study showed the density of tissue with in the ring is hypodensity in 2(28.57%) cases and 5 (71.43%) cases of with edema.

Most common clinical symptom present in neurocysticercosis was seizures (85.71%). This study is similar to study was done by Garg RK *et al.*⁵ and reported that incidence of neurocysticercosis was 80% among those presented with seizures with ring enhancing lesions. Other clinical symptoms like blurring of vision and vocal difficulties etc.

In our study, 2 patients had a history of active TB and 2 patients had a history of known TB cases which is significant.

From the neuro examination study, it was observed that 1 case was left pure motor and 2 cases were Motor Hemideficit with cortical deficits.

In our study, Abscess was diagnosed in 5 cases and had a male predominance (male=3 and female=2). Contrast enhanced CT provides a rapid means of detecting the size, location and number of abscesses. In this study, 1 case was ring enhancing lesion in left medial temporal lobe with enhancement of ependyma of temporal and occipital horn of left lateral ventricle. This is in agreement with Phaneendra. 1 case was well defined ring enhancing lesion in right frontal parietal region with adjacent edema with midline shift, 1 case was well defined hypodensity in left frontal region with surrounding edema, 1 case was thick regular ring enhancing lesion in the subcortical white matter in temporal lobe with left ear cholesteatoma. This is in agreement with Mahato *et al.*⁸. 1 case was regular smooth margin ring enhancing in the left frontal region with perilesional edema. It is observed in our study that cases diagnosed with cerebral abscess had an associated finding in the CT imaging like

ventriculitis and left ear cholesteatoma which helps in fetching the diagnosis and also the source of infection. Most common clinical symptom present in abscess was other positive history like nausea, blurring of vision, slurring of speech, disorientation and ear problem etc. followed by headache and seizures. Some of patients were known case of ASD, active cholesteatoma and recent history of head trauma.

From the neuro examination study, it was observed in 1 case was Sensory aphasia memory impairment, 1 case was Cranial nerve, 2 cases were Higher cerebral Dysfunction.

In our study, out of 25 patients evaluated Toxoplasmosis was seen in 2 cases and both were equal predominance (male=1 and female=1). 1 case was ring enhancing lesion in right Basal Ganglia with Leptomeningeal enhancement. Another case was small and well-defined ring enhancing lesion in sub cortical region of left parietal lobe.

Most common clinical symptoms present in abscess were other positive history like difficult to speak and diplopia, headache, fever and weakness. These clinical symptoms are equal in precedence. It was observed that both patients were immunocompromised (retroviral disease).

From the neuro examination study, it was observed in 1 case had a pure motor and 1 case had a motor Hemideficit with cortical deficits.

Out of 25 patients, 1 case was Metastasis of male patient. In this study, thick walled ring enhancing lesion with central non enhancing necrotic area noted in right frontal lobe in parafalcine location with adjacent disproportionate edema. The patient history was known case of lung carcinoma with metastasis to liver. CT and MRI remain the primary modalities utilized for the detection of metastatic tumors of the CNS. CT is extremely useful in the setting of new neurological signs or symptoms, with or without a history of malignancy. Our findings were similar to the study conducted by David H. Johnson *et al.* in our study, patient presented with headache and weakness with other non-neurological symptoms like drowsiness, pain in abdomen, loss of appetite and loss of weight which indicated mainly the other systemic organ involvement. With the background that the patient was known case of lung carcinoma with mets to liver, metastasis was diagnosed from the neuro examination study, it was observed that a case was motor hemideficit with cortical deficits

Out of 25 patients, 1 case was CNS Lymphoma of female patient. Ring enhancing lesion with surrounding edema in right parietal was evaluated in this study. I. S. Haldorsen *et al.*⁹ have reported the 75 patients in the study sample. Out of 75 patients, 68 (91%) had contrast enhanced imaging and 7 (9%) had non-contrast enhanced imaging. CT images were reviewed in 66 of the 75 patients. MR images were reviewed in 52 of the 75 patients and 43 of the 75 patients, both CT and MR images were reviewed. For patients with both CT and MR images (n = 43),

median (mean, range) time from the first imaging technique (CT in 39 patients, MR imaging in 4 patients).

Most common clinical symptoms present in metastasis were other positive history like blurring of vision, diplopia, headache, fever and seizure. These clinical symptoms are in equal precedence. The risk factor of patient was a known case of ASD.

In this study, 2 (male=1 and female=1) cases of meningiomas were seen. 1 male case was Glioblastoma Multiforme (GBM) with thick irregular ring enhanced lesion in the right frontoparietal region with surrounding vasogenic edema and mass effect was evaluated. Amr A Abd-Elghany *et al.*¹⁰ have analyzed and characterized CT and MRI scan of GBM patients. For the analysis 130 definite GBM patients were considered. The average size of GBM was 19.17 ± 14.29 cm² with relative symptoms of seizure (14.6%), headache (30.1%), seizure with headache (1.19%) and other complications (53.4%). In our study, symptom of seizure with headache and drowsiness were seen with left hemiparesis with cortical dysfunction.

Another case was female patient with well-defined hypodense extra axial lesion with broad base towards dura noted in left high parietal region on post contrast shows heterogeneous enhancement. The clinical symptoms were presence of seizure with headache, weakness, vomiting and photophobia. P.M. Latorre *et al.*¹¹ have conducted an analysis of MRI and CT of patients with meningiomas and concluded that meningiomas usually present with typical radiological features. The cases with atypical imaging findings with/without unusual locations may render their diagnosis challenging.

From the neuro examination study, it was observed that 2 cases were motor hemideficit with cortical deficits in our study, 1 out of 25 patients was diagnosed with neurosyphilis. Well defined small ring enhanced lesion in frontal region with perilesional edema and meningeal enhancement were seen. Fuhua Peng *et al.*¹² have studied 14 HIV negative patients with neurosyphilis, out of which 6 cases of presence of cerebral infarction, 4 cases of arteritis, 3 cases of nonspecific white matter lesion, 1 case of acute syphilitic meningitis and 1 case of normal. The analysis was carried out using CT and MRI. Finally results were suggested that image findings have some characteristic manifestations in the patients of neurosyphilis. The clinical symptom was other positive history like drowsiness slurring of speech, inability to recognize the person. The risk factor was active syphilis (VDRL +ve) and neurological disorder was Memory impairment.

CONCLUSION

- Size and extent of lesion in CT scan does not correlate with severity of lesion clinically.
- Out of 25 cases, 12 cases were had a risk factors like 2 cases of known TB, 2 cases of active TB, 1

case of trauma, 2 cases of RVD, 1 case of primary malignancy, 1 case of seizure disorder and 2 cases of others.

- 14 cases were found the neurological disorders, out of these, 3 cases had a pure motor, 7 cases of motor hemideficit with cortical deficits, 1 case of cranial nerve and 3 cases of higher cerebral dysfunction.
- The different cases had a different site selection. 13 cases were in brain parenchyma, 5 cases were in Subcortical region, 3 cases were in Gray white matter junction, 3 cases were in Periventricular region and 1 case was in Meninges.
- With the availability of neuroimaging studies such as CT, MRI and nuclear scans, patients who have single ring lesions refractory to medical treatment may be subjected to more efficient neurosurgical procedures like stereotaxic biopsy for better diagnosis and treatment.

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