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Original Article

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Differentiating Between Solitary Ring Enhancing Neurocysticerosis and Tuberculoma: Prospective Cross Sectional Study in Adult Population

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Abstract

Background: Tuberculoma and neurocysticercosis of the brain remains a diagnostic challenge. MR Spectroscopy is a potential tool for differentiating between infectious and non-infectious lesions. This study was undertaken to assess differentiating characteristics on MRI and MR Spectroscopy of solitary tuberculoma and neurocysticercosis. **Subjects and Methods:** This was a prospective cross sectional study conducted in the Department of Radiodiagnosis of JNMCH, Aligarh over a period of 3 years performed on 1.5T Siemens MR scanner. 100 patients with brain imaging finding of a solitary ring enhancing lesion (SREL) were consecutively included in the study and further worked up and the patients with the final diagnosis of tuberculosis or neurocysticercosis were evaluated with MR Spectroscopy. **Results:** Out of 100 patients, 86 were positive for nerocysticercosis or tuberculoma. The maximum numbers of cases were seen in the second and third decade of life. The overall male to female ratio in our study was~ 2:1. MR Spectroscopy in tuberculomas showed a lipid peak in 81% cases which was not seen in neurocysticercosis. MR Spectroscopy showed statistically significant difference in the ratios of CHO/CR and CHO/NAA in tuberculoma and neurocysticercosis. The ratio of CHO/CR, CHO/NAA, and NAA/CR was less than 1.5 in 83%, 88%, and 95% cases of neurocysticercosis, respectively. **Conclusion:** MRI + MR Spectroscopy can help to differentiate between them and MR Spectroscopy should be a part of routine brain MRI for cases with SREL.

Keywords: MRI – Magnetic resonance Imaging, NCC - Neurocysticerosis, MR spectroscopy - Magnetic resonance spectroscopy, SREL- Solitary ring enhancing lesion.

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Introduction

Solitary ring enhancing lesion (SREL) in brain imaging is a frequently encountered feature in Indian sub-continent. In a developing country, the etiological spectrum seems to be different from the western world, the two most frequently etiologies are tuberculoma and Neurocysticerosis (NCC). It is difficult to differentiate them because both the diseases are prevalent and share common clinico-radiological features. Accurate diagnosis is essential to provide proper treatment. Computed tomography (CT) and magnetic resonance imaging (MRI) are the most widely used imaging to detect these lesions. Often, diagnostic challenge is stiffer than expected and exact diagnosis is not forthcoming even after proper clinical evaluation and a battery of investigations.

Magnetic resonance spectroscopy (MRS) helps in differentiating between infectious and non-infectious lesions. MRS provides information about the possible extent and nature of changes by analysing the presence and/or ratio of different tissue metabolites such as NAA, creatine, choline, and lactate etc.[1]

The present study was undertaken to study the MRI and MRS characteristics of tuberculoma and NCC with the aim to differentiate the lesions based on the characteristics on MRS.

Subjects and Methods

The present study was conducted in the Department of Radiodiagnosis of Jawaharlal Nehru Medical college and hospital, Aligarh over a period of three years from November 2013 to November 2016. One hundred patients with brain imaging finding of a SREL were consecutively included in the study. These patients were then worked up to for the cause of the SREL in the Departments of Medicine and Neurosurgery, Jawaharlal Nehru Medical College and hospital. The patients with the final diagnosis of tuberculosis or neurocysticercosis were evaluated with MRS.

Study Design: This was a prospective cross sectional study.

Method of Data Collection:

Any patient undergoing MRI in the Department of Radiodiagnosis with brain imaging finding of SREL on contrast enhanced MRI were included in the study and those which were confirmed to be tuberculosis or neurocysticercosis had MRS evaluation done.

A detailed clinical history was noted in all the patients with SREL. Detailed past, family and personal history was also taken in all the patients. A thorough general and systemic examination, especially evaluation of neurological status was done in view of different etiologies for such a presentation.

For the diagnosis of Cysticercosis, positive enzyme-linked immunoelectron transfer blot assay was mandatory. Also presence of a normal chest radiograph to exclude tuberculosis was also performed in these patients. Tuberculosis was confirmed by demonstration of acid fast bacilli in the sputum culture of these patients or patients with confirmed tuberculosis or contact with active pulmonary tuberculosis living in the same house.

Inclusion Criteria:

- Patients of all age group except paediatric age group.
- Patient with imaging finding of SREL and confirmed tuberculosis or neurocysticercosis were taken for MRS.

Exclusion Criteria:

The study excluded

- Paediatric population were not included due to technical difficulties
- Known allergy to contrast materials.
- Deranged Renal Function Test (serum creatinine level >2.5mg/100ml of blood).
- Post-operative cases.
- Patient having history of claustrophobia.
- Patient with contraindication for MRI such as cardiac pacemakers and Metallic foreign body in situ.

Equipment and Technique Used

MRI on 1.5T MR Scanner (MAGNETOM AVANTO, SIEMENS, GERMANY) was used for the study.

Imaging Techniques:

Patients were examined in supine position with proper positioning and immobilization of the body. Standard head coil was used in MRI.

MR Imaging

On MRI Conventional spin echo sequences, axial T1, T2 and FLAIR; Sagittal T1; Post contrast axial, coronal and sagittal; DWI and GRE/SWI sequences were obtained. OptimarkTM (Gadoversetamide) contrast injection was administered (IV route) in the dose of 0.1mmol/kg and post contrast fat saturated T1-weighted images were obtained. In-Vivo proton MR spectroscopy was performed using chemical shift imaging with intermediate TE (time to echo) of 135 ms and TR (time of repetition) of 1500 ms. the voxel was placed on the lesion so that it covers the maximum area of the lesion. The voxel was so placed to avoid any bone, CSF within the voxel as they cause too much noise. We used T1 post contrast sequence as localization sequence.

On MR spectroscopy ratios of CHO/CR, CHO/NAA and NAA/CR was obtained and compared.

Final diagnosis was made by correlating the imaging finding and available clinical data of the patient. The radiological diagnosis was correlated with the provisional clinical diagnosis based upon the clinical outcome of the patient.

Statistical analysis

Statistical presentation and analysis of the present study was conducted using arithmetic mean, percentage and standard deviation. Student t- test was used to determine the significance between two groups. Unpaired two tail t-test was used for explore parameter relationships and comparison among different variables in quantitative data of two groups. Parameter values were expressed as mean and standard deviation (SD). P- Values of less than 0.05 were considered statistically significant. Statistical analysis was performed using MS Excel 2010 and IBM SPSS statistical software package.

Results

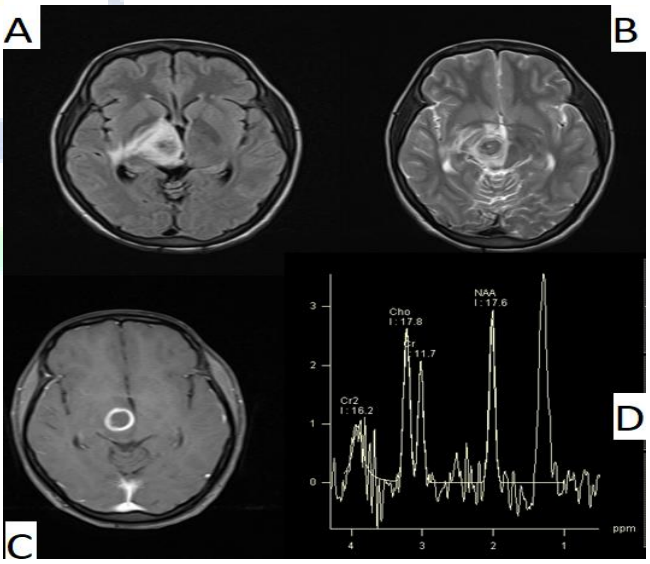

Figure 1: Flair (A) and T2WI (B) of a female patient who presented with weakness in limbs shows iso-hypointense lesion in the Right thalamus which shows no inversion on FLAIR (ruling out cystic nature of the lesion) with perilesional edema. Post-contrast T1WI (C) shows ring enhancing lesion with smooth both inner and outer wall. MR Spectroscopy (D) of lesion shows prominent lipid peak at 1.3 ppm with CHO/NAA ratio ~1 and CHO/CR ratio~1.5. This turned out to be tuberculoma.

The age distribution of the patients was relatively wide, ranging from 15-70 years. [Table 1] All the lesions were more common in males (62.7%) compared to females (37.3%) [M:F=1.7:1]. The maximum numbers of cases were seen in the second and third decade of life. Patients of paediatric age were excluded from study due to technical difficulty in anaesthesia and image acquisition.

Tuberculoma and neurocysticercosis were almost equal in incidence in our study the major cause of ring enhancing lesions. The rest fourteen cases of SREL included causes such as metastasis, Glioblastoma multiforme, demyelination and hematoma.

The neuroimaging feature of tuberculoma in terms of laterality, location, number and size has been summarized in [Tables 2-4]. In 55% cases, lesions were supratentorial in location. 27% cases had lesion in both supra and infratentorial in location. 70% cases of tuberculoma had the lesion size upto 2cm while 73% of neurocyticercosis were less than 1 cm.

MR spectroscopy metabolite ratio of different patients who had tuberculoma and neurocysticercosis as ring enhancing lesion on MRI have been summarized in [Table 5,6]. 37 (88%) cases of NCC had CHO/NAA ratio less than 1.5 as compared to tuberculoma which has 23 (52%). Only two patient of neurocysticercosis had NAA/CR ratio >1.5. Comparing the means of CHO/CR, CHO/NAA and NAA/CR in tuberculoma with that of NCC using unpaired t –test we have noted a significant difference in ratios of CHO/CR (p=0.007) and CHO/NAA (p=0.01) due more increase in choline level in tubercular lesion. However, there is no significant difference in noted in the ratio of NAA/CR (p=0.7)

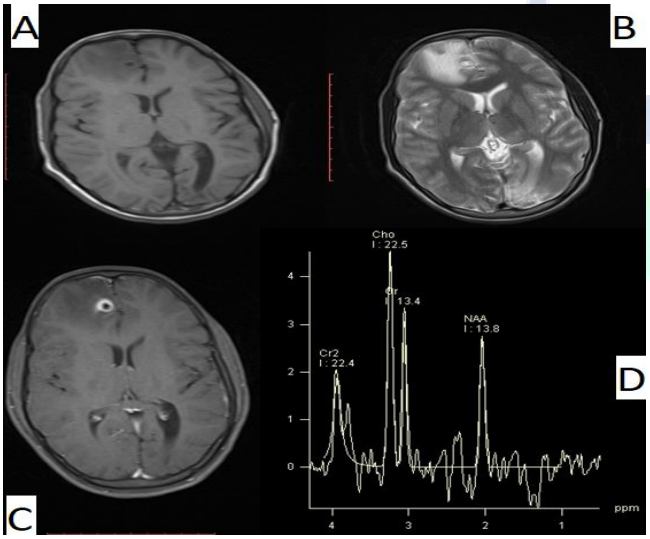

Figure 2: T1WI (A) of a male patient who presented with seizure shows hypointense lesion in right frontal lobe in parasaggital location at grey-white matter junction which on T2WI (B) appears hyperintense with surrounding perifocal edema with thin hypointense rim suggestive of cystic nature of lesion. On Post Contrast image Fat sat T1WI (C) shows ring like enhancement with thin smooth wall. On MRS (4) shows mild elevation of CHO and reduce NAA with lactate doublet at 1.3ppm. This turned out to be neurocysticercosis.

Table 1: Distribution Of Etiology On The Basis Age-Group

Age Group	Tuberculoma	NCC	Total
11-20	12	22	34
21-30	13	10	23
31-40	8	5	13
41-50	8	4	12
51-60	3	1	4

Table 2: Cases and Laterality of the Lesion in Brain (N=86)

Laterality	TB Cases (%)	NCC Cases (%)
Right	14(32)	18(43)
Left	12(27)	17(40)
Bilateral	14(32)	7(17)
Midline	4(9)	-

Table 3: Location of Lesion in Relation to Tentorium (N=86)

Location	TB Cases (%)	NCC Cases (%)
Supratentorial	24(55)	38(90.5)
Infratentorial	8(18)	-
Both	12(27)	4(9.5)

Table 4: Number of Cases and Size of the Lesion (N=86)

Size in CMS	TB Cases	NCC Cases
<1	9(20)	31(73.8)
1.1-2	22(50)	9(21.4)
>2	13(30)	2(4.8)

Table 5: MRS Metabolites Ratios of Tuberculoma (N=44)/ NCC (N=42) (N is Number of Patients)

MRS Finding	TB/NCC ratios		
RATIOS	CHO/CR	CHO/NAA	NAA/CR
<1	7/13	12/28	14/13
1-1.5	21/22	11/9	25/27
>1.5	16/7	21/5	5/2

Table 6: MRS Metabolites Ratio (Mean and Standard Deviation) of Both Etiologies

Etiology	CHO/CR	CHO/NAA	NAA/CR
Tuberculoma	1.73±0.89	1.59±0.88	1.24±0.50
NCC	1.23±0.32	1.12±0.43	1.21±0.34

Discussion

Tuberculoma and NCC lesions of the brain remain a diagnostic challenge. An attempt has been made to establish the etiological diagnoses of the brain in adult population using MRI.

Tuberculomas were more common than NCC. Garg RK (2004),[2] also found infective etiology as most common cause of ring enhancing lesion in Indian population. In contrast to Schwartz et al (2006),[3] who reviewed 221 ring enhancing lesions seen on MRI studies and reported that gliomas (40%), metastases (30%), abscesses (8%) and demyelinating disease (6%) are more common in the western population.

On T2 weighted images, the tuberculomas show hyperintense rim in 30% cases with loss of signal intensity of core. Similarly, Wasay M et al, (2003) also noted a hypointense core with a hyperintense rim as the most common signal characteristic on the T2-weighted image.[4]

MRS in tuberculomas showed a lipid peak in 28 (63.6%) cases and 8 (18%) cases show lipid and lactate peak, rest showed no lipid /lactate peak. Jayasunder R et al, (1999) concluded that presence of lipid, which was seen in 86% of the cases, can be used for differentiating tuberculomas from both non-specific inflammatory granuloma and NCC.[5] Similar finding were also noted by Gupta RK et al,1993.[6]

MRS in NCC showed Choline peak in 38% case (16 out of 42) and 38% percentage of cases showed reduced NAA

peak. Small Lactate peak is seen in the 44.4% case (out of 38) and no lesion shows lipid peak in any of the cases diagnosed as NCC. These are similar to the finding noted by Pandit S et al, (2001).[7]

The ratios of CHO/CR, CHO/NAA, and NAA/CR in tuberculoma greater than 1.5 was seen in 36.3%, 47.7% and 11.3% respectively (n=44). In our study, Cho/Cr ratio greater than 1 was noted in 84.1% and slightly contradicts with the study by Pretell et al, (2005) who noted that choline/creatine ratio was greater than 1 in all tuberculomas.[8] However, their study sample was small and included only 6 cases of tuberculomas.

The mean and standard deviation of CHO/CR, CHO/NAA, and NAA/CR is 1.73±0.89, 1.59±0.88 and 1.24±0.50 respectively in tuberculoma patients in our study. Kumar A et al, (2003) described mean CHO/CR ratio of 1.24 ± 0.18 in tubercular lesions.[9]

The ratio of CHO/CR, CHO/NAA, and NAA/CR was less than 1.5 in 83%, 88%, and 95% respectively in cases of NCC. These ratios fairly correlating with a study done by Kumar A et al, (2003) and is inslight discordance with a study done by Jayasunder et al, (1999), they noted that CHO/CR <1 in all NCC patients (n=10).[5,9]

The mean and standard deviation of Ratios of CHO/CR, CHO/NAA, and NAA/CR is 1.23±0.32, 1.12±0.43 and 1.21±0.34 respectively in our study in NCC patients.

Comparing the means of various metabolites (CHO/CR, CHO/NAA and NAA/CR) in tuberculoma with that of NCC using unpaired t-test, significant difference in ratios of CHO/CR (p=0.007) and CHO/NAA (p=0.01) was seen. The most probable explanation we could infer is that this is due more increase in choline level in tubercular lesions.

However, there is no significant difference in noted in the ratio of NAA/CR (p=0.7). This is due to the fact that there is less alteration in the metabolite NAA and CR in both NCC and tuberculoma as both are benign conditions.

Conclusion

MRI has emerged as the modality of choice for evaluating various causes of SREL.

1. MRI + MRS can contribute to differentiate between tuberculoma and NCC and shows significant difference in ratios of CHO/CR and CHO/NAA.
2. We recommend that MR spectroscopy should be a part of the routine MR examination for cases with suspected intracranial ring lesion as it could increase the imaging diagnostic efficiency.

Limitations of the study:

The histopathological correlation was not done because of ethical issues and all of these patients were followed by imaging only.

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