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MRI In White Matter Diseases Clinico Radiological Correlation

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Abstract

Background: Demyelinating disorders are a heterogeneous group of diseases described as centralwhite matter disease, in which myelin loss exceeds axonal loss. The result of demyelinating diseasesis the thinning or even focal disappearance of the myelin sheath of axons. Such changes will affectsignal propagation in affected axons; depending on their location, this can lead to a host of neurologicandpsychiatric symptoms.

Aim of the study: To analyze the practical approach of MRI in white matter diseases of adult brain.

Objectives of the study: To study the distribution and nature of MRI findings in white matter diseases of adult brain and to establish an accurate diagnosis and to narrow down the differential diagnosis in various white matter diseases.

Materials and methods: The present study was conducted in the Department of Radiology, Great Eastern Medical College Srikakulam for a period of 12 months from August 2020 toJuly2021. It was an observationalstudy involving 50 cases, who were above 14 years of age with clinical suspicion / diagnosis of whitematter lesion, referred to the Department of Radiology for MRI irrespective of sex. Patients withclinical suspicion / diagnosis of white matter lesion referred to MRI with age more than 14 years andof both sexes, both out patients and in patients were included in the study. Exclusion criteria were patients with MRI non-compatible implants in their body in any form (pacemaker, orthopedic implants etc., patients with claustrophobia, unstable patients on life support mechanism, patients notwilling to give the consent and all the patients with age related vascular causes were not included inthestudy.

Results: The present study had been carried out for a period of 12 months among 50 adult patients aged 15 years and above who were referred for MRI to the department of Radio diagnosis, with clinical suspicion or diagnosis of white matter disease. 62% of the study population belonged to the age group of 15 to 34 years. There after a decreasing trend of the white matter lesions was observed with increase in age. Out of 50, only 2 cases (4%) belonged to age 65 years and above. Out of 50 cases studied, 27 (54%) were females and23 (46%) were males. Out of the total 50 cases studied, majority of the cases were of ADEM (28%)followed by PRES (20%). 5 cases each of ODM, MS and DAI were seen (10% each). 3 cases (6%) ofCADASIL,2 cases (4%) eachofTDM, PML, CTXand MBDwereobserved.

Conclusion: MRI due to its excellent gray-white matter resolution is very sensitive in detecting subtlewhite matter changes. The present study concludes that MRI, in correlation with DWI, MRS, MRcontrast in required cases is an ideal modality in early diagnosis of white matter diseases and aids intheearlyinstitutionof therapyso that the curable conditionsamongthemcan betreated.

Keywords: MRI;White matter; Brain

Introduction

Demyelinating disorders are a heterogeneous group of diseases described as ―central white matter disease‖, in which myelin loss exceeds axonal loss. The result of demyelinating diseases is the thinning or even focal disappearance of the myelin sheath of axons. Such changes will affect signal propagation in affected axons; depending on their location, this can lead to a host of neurologic and psychiatric symptoms [1]. Primary demyelinating disorders, infectious, neoplastic, post-traumatic and metabolic disorders are the most common. When white matter disease is encountered on an imaging study, it is useful to first characterize the white matter involvement as multifocal, confluent/ diffuse, or selective (geographic). This approach, combined with the clinical information regarding patient demographics, clinical history and physical findings, helps the imager limit the differential diagnosis. If the white matter abnormalities are confluent, the next most helpful MRI discriminator concerns with the identification of predominant localization of the abnormalities. The major preferential localizations are frontal, parietal-occipital, temporal, periventricular, subcortical, diffuse cerebral and posterior fossa. Special MRI features are typically seen in a number of specific disorders and have a significant diagnostic value [2]. MR characteristics are as per.

The advent of MR has revolutionized the concept of understanding of white matter diseases. MRI is considered far superior to CT and is the imaging modality of choice in white matter diseases. (Figure 1) Further, with the advent of multi-echo sequences of MR, even subtle lesions of demyelination can be detected. A correct diagnosis could be made in majority of the patients based on MR findings and clinical history alone. MR, in conjunction with clinical findings, plays a significant role in establishing the diagnosis and in the further follow up of patients with white matter diseases [3].

Materials and methods

The present study was conducted from August 2020 to July 2021. It was an observational study involving 50 cases who were above 14 years of age with clinical suspicion/ diagnosis of white matter lesion, referred to the Department of Radiology for MRI, irrespective of sex.

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Inclusion criteria

- Patients with clinical suspicion/ diagnosis of white matter lesion referred to MRI with age more than 14 years and of both sexes.
- Both out patients and in patients were included in the study.

Exclusion criteria

- Patients with MRI non-compatible implants in their body in any form (pace maker, Orthopedic implants etc.
- Patients with claustrophobia.
- Unstable patients on life support mechanism.
- Patients not willing to give the consent
- All the patients with age related vascular causes were not included in the study.

Examination technique

All the MRI sequences were obtained on 1.5 Tesla MRI machine ‗GE Signa'1.5T Signa Excite system (General Electric Medical Systems, Milwaukee, USA). A dedicated eight channel high resolution head coil was used.

Method

After obtaining informed consent, general data regarding age, sex, symptoms, history of present illness, past and personal history, smoking habit, alcohol consumption, etc. were noted. Axial sections of T1, T2 and FLAIR images of MRI were obtained from all the patients. Diffusion weighted MR sequence was also performed in all the patients. Post contrast T1 images and MR spectroscopy were obtained in required patients only. MR imaging data of each patient regarding distribution and nature of the white matter lesions viz., region of involvement, signal characterization, presence or absence of diffusion restriction, presence or absence of contrast enhancement, levels of metabolites in MR spectroscopy, etc. were noted.

Data analysis

Statistical analysis of the data was performed by using Microsoft Excel. Data was represented in the form of frequencies and percentages with the help of tables, bar diagrams (Figure 2).

Results

The present study had been carried out for a period of 12 months among 50 adult patients aged 15 years and above who were referred for MRI to the department of Radio diagnosis, with clinical suspicion or diagnosis of white matter disease. 62% of the study population belonged to the age group of 15 to 34 years. Thereafter, a trend of the white matter lesions was observed with increase in age. Out of 50, only 2 cases (4%) belonged to the age range of 65 years and above. Out of 50 cases studied, 27 (54%) were females and 23 (46%) were males. Out of the total 50 cases studied, majority of the cases were of ADEM (28%) followed by PRES (20%). 5 cases each of ODM, MS and DAI were seen (10% each). 3 cases (6%) of CADASIL, 2 cases (4%) each of TDM, PML, CTX and MBD were observed. In most of the white matter diseases, younger age group is commonly involved except in ODM and CTX. All the 5 cases in ODM belonged to the age group of 45 years and above. Both the cases of observed CTX belonged to middle age (45 to 54 years). There was not much of a difference in sex distribution of overall white matter lesions in the considered study population, 27 females (54%) and 23 males (46%). Among individual diseases, female preponderance was observed in PRES (M: F = 1: 9) and MS (M: F=1:4), while male preponderance was observed in DAI (all the 5 cases were males) as per (Table 1).

Out of 14 cases of ADEM, 9 cases (64%) belonged to 15 to 34 years age group. Thereafter with increase in age, there was a decrease in the number of cases of ADEM. Out of 14 cases of ADEM, 6 were females (42.9%) and 8 were males (57.1%) as per (Table 2).

On MR imaging of brain T1 hypo intense, T2 and FLAIR hyper intense lesions were noted in ADEM patients. Predominant site of involvement was subcortical white matter (85.7%) followed by brain stem (35.7%) and basal ganglia (35.7%). Thalamus and periventricular white matter were involved in 28.5% of cases each. Cerebellum involvement was seen in 14.3% of cases. On contrast administration 4 out of 14 cases (28.5%) showed discrete enhancing lesions. All the 10 cases of PRES were of below 35 years age. 9 out of 10cases were females. These 9 females were known preeclampsia patients and presented with high blood pressures. One male who was a known case of hypertension presented with head ache, high B.P and vision loss (Table 3).

MR imaging showed T1 (4 cases-is intense, 6 cases-hypo intense), T2 and FLAIR hyper intense lesions. The common site involved in PRES was occipital or parietal region (80%). Frontal lobe, inferior temporal region and cerebellum were involved in 40% cases each. In 20% of the cases, brain stem was involved. On DWI 2 cases, (20%) showed a few areas of restricted diffusion in subcortical regions of both cerebral hemispheres, which appeared is intense on ADC map. All the 5 cases of ODM observed were of 45 years and above, 2 females and 3 males. All these cases were end stage renal disease patients on hemodialysis. Pons was involved in 100% of the cases of ODM. Thalamus and midbrain were involved in 40% of the cases each. All the cases

(5) Of multiple sclerosis in our study showed lesions in corpu callosum. Periventricular region was involved in 80% (4) of the cases. Cortical white matter, brain stem, spinal cord and optic nerve involvement was seen in one case (20%) each. In 4 cases (80%) lesions have ovoid configuration with the major axes perpendicular to the ventricular surface (Dawson's fingers) which are associated with the

Disease	No.of cases	percentage
ADEM	14	28%
PRES	10	20%
ODM	5	10%
MS	5	10%
DAI	5	10%
CADASIL	3	6%
TDM	2	4%
PML	2	4%
CTX	2	4%
MBD	2	4%
TOTAL	50	100

Table 1: Prevalance of white matter lesion (n=50).

Age in years	Female	Male	Total
15to24	2(50.0%)	2(50%)	4(28.6%)
25to34	3(60%)	2(40%)	5 (35.7%)
35to44	1(50%)	1(50%)	2 (14.3%)
45to54	--	2(100%)	2 (14.3%)
55to64	--	1(100%)	1 (7.1%)
≥65	--	0	0
Total	6(42.9%)	8(57.1%)	14(100%)

Table 2: Age and sex distibution of ADME Lesion (n=14).

Site of lesions	No. of cases	Percentage (%)
Cerebral white matter (predominantly subcrotical)	12	85.7%
Brain stem	5	35.7%
Basal ganglia	5	35.7%
Thalamus	4	28.5%
Periventricular white matter	4	28.5%
Cerebellum	2	14.3%

Table 3: Site of lesion in ADME.

Site of lesions	No. of cases	Percentage (%)
Occipital/Perietal	8	80%
Frontal lobe	4	40%
Inferiar temporal	4	40%
Cerebellum	4	40%
Brain stem	2	20%

Table 4: Site of lesions in PRES.

inflammatory changes around the long axis of the medullary vein that create the dilated perivenular space (Table 4).

Diffuse axonal injury

Out of 5 cases of DAI, two cases were grade III, two were grade II and one case was grade I. All were males of 25-34 years age group with mean age of 29.2years. All these 5 cases presented with history of polytrauma. Involvement of corpus callosum was seen in 4 out of 5 cases (80%). Brain stem was involved in two cases (40%). Thalamus and basal ganglia were involved in one case (20%) each.

Cadasil

All the 3 cases of CADASIL belonged to 35 to 44 years age group. 2 were females, 1 male. On MR Imaging T2 and FLAIR hyper intense areas were observed in external capsule and anterotemporal white matter in all the 3 (100%) cases. Periventricular and subcortical region was also involved in all the 3 cases (100%). Corana radiate was involved in 2 cases (66.7%), brainstem in 2 cases (66.7%). All the three cases showed subcortical infarcts.

Tumefactive demyelination

Two cases of Tumefactive demyelination were reported in our study. Both were females (28 and 50 years). Both patients presented with gradual progressive loss of vision with one case having complete vision loss at the time of presentation. MR in both patients showed symmetrical T1 hypo intense, T2 FLAIR hyper intense lesion involving the periventricular and subcortical white matter of bilateral posterior temporal, occipital, parietal lobes extending across the selenium of corpus callosum. The lesions were showing no mass effect over the adjacent ventricular horns. On contrast administration, both the cases showed irregular incomplete ring enhancement with open side of the ring towards the cortex. MRS in both the cases showed elevated lactate, reduced NAA, increased choline, elevated glutamate, reduced NAA/Ch ratio. DWI showed restricted diffusion in the periphery of the lesion with hypo intense signal in center which appeared as hyper intense center with is to hypo intense periphery on ADC maps.

Progressive multifocal leukoencephalopathy

The 2 cases of PML were HIV positive males (32 and 27years). MRI showed well defined lesions appearing hypo intense on T1, hyper intense on T2 and FLAIR involving the subcortical white matter of bilateral frontal and right parietal lobes with no mass effect. Basal ganglia and thalamus were involved in one case. On contrast administration no obvious enhancing lesions and no evidence of cortical atrophy were noted. MRS showed reduced NAA, elevated choline, normal keratinize and reduced NAA/Ch. ratio.

In addition, our patient‘s CSF was positive for JC virus which supported our diagnosis.

Cerebellar tendon xanthomatosis

Both the cases of CTX were females belonging to 45 to 54 years age group. Both of them showed symmetrical T2 hyper intensities in bilateral cerebellar hemispheres involving dentate nucleus. Cerebellar foliageis prominent with dilated fourth ventricle. Both the patients presented with cataract and Achilles tendon xanthomas.

Marchiafava bignami disease

The two cases of MBD observed in our study were chronic alcoholic males of age 36 years and

22 years old. T2 and FLAIR hyper intensities with diffusion restriction noted in body and selenium of corpus callosum in both the cases. With the administration of thiamine, both cases showed improvement in clinical symptoms.

Discussion

The present study has been carried out for a period of 12 Months among 50 adult patients aged 15 years with clinical suspicion or diagnosis of white matter disease. 62% of the study population belonged to the age group of 15 to 34 years. There after a decreasing trend of the white matter lesions was observed with increase in age. Out of 50, only 2 cases (4%) belonged to age 65 years and above. Out of 50 cases studied, 27 (54%) were females and 23 (46%) were males. Out of the total 50 cases studied, majority of the cases were of ADEM (28%) followed by PRES (20%). 5 cases each of ODM, MS and DAI were seen (10% each). 3 cases (6%) of CADASIL, 2 cases (4%) each of TDM, PML, CTX and MBD were observed.

Acute disseminated encephalomyelitis (ADEM)

14 cases (8 males, 6 females) were diagnosed with ADEM. All the 14 cases have history of fever prior to the onset of clinical symptoms. In addition, 4 patients presented with altered sensorium, 2 patients with double vision, 2 patients with 3 episodes of seizures. The age group varied through a wide range of 19 to 52 years with male: female ratio of 2:1.5.However, Kesselring J, et al. [4] in their study had noted a male female ratio of 1.4:1. In our series, all the cases were adults with mean age of 31 yrs. According to literature, ADEM can occur in all ages, although most reported cases are in children and young adults. However, study done by Schwartz S et al on occurrence of ADEM in adult patients consisting of 40 cases showed the mean age as 33.5 years which is comparable with our result. In our study on MR imaging, T1 hypo intense, T2 and FLAIR hyper intense lesions were noted, of which majority were located in subcortical white matter of both cerebral hemispheres (12/14 cases-85.7%), followed by brain stem (5/14 cases-35.7%), cerebellar white matter (2/14 cases-14.3%). Brain stem and /or cerebellum involvement in 43% of cases

On comparison, R.C. Dale, et al. [5] showed that involvement of the deep and subcortical white matter was nearly universal (91%), brainstem and /or cerebellum were involved in 87% of cases. The thalami and / or basal ganglia were involved in 69% of cases. Periventricular region was involved in 44% none of the patients showed involvement of spinal

cord. In Mikealoff, et al. [6] study, cerebellum and /or brain stem were involved in 68%, thalamus and/ or basal ganglia were involved in 63%, and juxtacortical region was involved in 66% of cases. In Linn, et al. [7] study, cerebellum and brain stem were involved in 77%, thalamus and basal ganglia were involved in 62%, periventricular region was involved in 60%, and cortical region was involved in 43% of cases. In our study, thalamic involvement was seen in 4 out of 14 cases (28.5%) and basal ganglia was involved in 5 out of 14 cases (35.7%), thalamus and /or basal ganglia in 50% of cases. Our findings were consistent with the study done by Baum PA, et al. [8] which showed that thalamic involvement is reported to be rare in multiple sclerosis, and may prove useful in distinguishing between ADEM and the initial presentation of multiple sclerosis. On contrast administration, out of 14 cases, 4 cases (28.5%) showed discrete enhancing lesions with one case showing incomplete ring type of configuration. These findings were comparable with the observations done by Van der Knapp, et al. [9] and Nathan P Young, et al. [10] which showed the white and/or gray matter lesions may enhance, but usually not all lesions enhance, and contrary to what is usually stated, their experience is that in many cases enhancement is at most subtle or is not present at all (Table 5).

Posterior reversible encephalopathy syndrome (hypertensive encephalopathy)

10 cases of PRES of which 9 were female and 1 male with a sex ratio of male to female 1: 9. Of the 10 cases, 9 were known case of preeclampsia and presented with high blood pressures. One male who was a known case of hypertensive presented with head ache, high B.P and vision loss. MR imaging showed T1 (4 cases-is intense, 6 cases-hypo intense) T2 FLAIR hyper intense lesions affecting the subcortical white matter of bilateral parietooccipital lobes (8/10 cases i.e. 80%), temporal lobes (4/10 cases i.e. 40%), frontal lobes (4/10 cases i.e.40%), brainstem (2/10 cases i.e. 20%) and cerebellum (4/10 cases i.e. 40%). These findings were comparable with study done by Donmez FY, et al. [11] who reported that the most commonly involved localizations in PRES were parietal lobe in 84.8%, occipital lobe in 72.7%, frontal lobe in 51.5%, temporal lobe in 33.3%, and cerebellum in 33.3%. Chou MC et al 19also suggested that involvement of anterior circulation region; brainstem, cerebellum, deep cerebral white matter, and thalamus are common in PRES (Table 6).

findings are also comparable with the study done by W.S. Bartynski, et al. [18], in which out of 136 patients, Vasogenic edema was consistently present in the parietal or occipital regions (98%), but other locations were common including the frontal lobes (68%), inferior temporal lobes (40%), and cerebellar hemispheres (30%). Involvement of the basal ganglia (14%), brain stem (13%), and deep white matter (18%) including the selenium (10%) was not rare. On DWI usually PRES does not show restricted diffusion, however in our series 2 case, 20% showed few areas of restricted diffusion in subcortical regions of both cerebral hemispheres which appeared is intense on ADC map. This a typical finding is comparable with study done by McKinney AM, et al. [12] who reported that restricted diffusion was the second most common

Atypical presentation of PRES in their study, accounting for 17.3%. The findings were also consistent with C J Stevens et al who stated that restricted diffusion as an associated finding has been described in PRES and has been shown to be potentially reversible.

Finding	RC dale, et al. [5]	Mikeal off, et al. [6]	Linn, et al. [7]	Prevalence in present study
Sb cortical white matter	91%	66%	43%	85.3%
T and/or BG	69%	63%	62%	50%
BS and/or CB	87%	68%	77%	43%
Periventricular	44%	-	60%	28.5%

Table 5: ADEM-Comparision of present study with existing studies.

Finding	Donmez FY, et al. study [11]	W.S. Bartynski, et al. [18]	Prevalance in present study
Sub cortical white matter of bilateral paieto occipital regions	Parietal (84.8%) & occipital (72.7%)	98%	80%
Temporal bone	33.3%	40%	40%
Frontal	51%	68%	40%
Cerebellum	33.3%	32%	40%

Table 6: Posterior Reversible encephalopathy syndrome Comparision of present study with Existing studies.

Osmotic demyelination syndrome

In the present study, 5 cases of osmotic demyelination syndrome were observed. All these five were end stage renal disease patients on hemodialysis. All the 5 (100%) cases showed T1 hypo to be intense and FLAIR hyper intensity on central pons. This is in favor of osmotic demyelination syndrome with demyelination or transient edema in pons. On comparison, N. Cagla Tarhan, et al. [13] study showed hyper intensity in central pons in 65% (11 out of 17) patients.

Thalamus and midbrain were involved in two cases (40%) each. Three cases (60%) show diffusion restriction on DWI. These findings are almost comparable to the findings of Jonathan Graff-Radford, et al. [14] in which pons was involved in all 22 patients (100%), followed by the thalamus (n=8 [36%]), midbrain (n=6 [27%]), cortical gray matter (n=3 [14%],

Hippocampus (n=3 [14%]), caudate (n=2 [9%]), putamen (n=2 [9%]), and middle cerebral peduncle (n=2 [9%]). Of 19 cases in which diffusion-weighted sequences were obtained, 10 (53%) demonstrated evidence of restricted diffusion. In Ramesha Nekkare Kallakatta, et al. [15] study of 25 patients with osmotic demyelination, Pons was involved in 19 patients (76%) Caudate 18 (72%) Putamen 19 (76%) Thalamus 5 (20%) Midbrain 4 (16%) Cortical grey mater (frontal and insular) 3(12%) Extra temporal cortical white mater 3 (12%) Hippocampus 2 (8%) Cerebellum 2 (8%), Medulla 1 (4%) and Sub thalamicnuclei 1 (4%) as per (Table 7).

Multiple sclerosis

Cases of multiple sclerosis noted, were between 21-44 years of age. Mean age of onset is 31.4 years. A distinct female preponderance was noted in our study group, with 4 females and 1 male (male: female = 1:4). All the above results were comparable with the studies done by BN Lakhkar, et al. and Gangopadhyay G, et al. In our study, MR imaging showed multiple discrete lesions appearing hyper intense on T2 and FLAIR images. Corpus callosum was involved in all five cases which was consistent with a prospective study done by Yulin Ge, et al. [11], who found that most of MS patients demonstrated confluent /

Findings	Jonathan Graff-Radford, et al. [14]	Ramesha nekkar kallakatta et al. [15]	Prevalence in prasent study
Pons	100%	76%	100%
Thalamus	36%	20%	40%
Mid brain	27%	16%	40%
Diffusion restriction	53%		60%

Table 7: Osmotic demyelination syndrom: Comperison of present study with existing studies.

focal lesions involving the calloso-septal interface and concluded that callosal involvement was specific for MS and also useful in assessing the relapse rates. But in BN Lakhkar, et al. study, out of 15 patient's only one patient had callosal atrophy. Involvement of periventricular white matter was seen in 4 out of 5 cases (80%). Brain stem, spinal cord and optic nerve were involved in one case (20%) each. These findings were similar to the results of study done by BN Lakhkar, et al. [16] which showed periventricular involvement in 80%, brain stem in 40%, spinal cord and optic nerve in 20% each. In Joost C. J. Bot, et al. [17] study done on 25 cases of multiple sclerosis, all the 25 cases showed periventricular Involvement. Juxtacortical lesions were present in 80% of patients. Infratentorial lesions were present in 84% of patients. Deep white matter lesions were present in 96% of patients. Enhancing focal lesions were observed 32% of patients. While in our study, in four cases (80%), lesions have ovoid configuration with the major axes perpendicular to the ventricular surface (Dawson's fingers) which are associated with the inflammatory changes around the long axis of the medullary vein that create the dilated perivenular space which is consistent with the findings of BN Lakhkar, et al. [3] and Yulin Ge, et al. [18] as per (Table 8).

Diffuse axonal injury

5 cases of DAI were observed, of which two cases were grade III, two were grade II and one case was grade I. All were males of 25-34 years age group with mean age of 29.2 years. these findings are comparable to Pamela W. Schaefer, et al., in which mean age is 25.2 years with a male and female ratio of 2.25. In present study, involvement of corpus callosum was seen in 4 out of 5 cases (80%). Brain stem was involved in two cases (40%). Thalamus and/or basal ganglia were involved in two cases (40%). These findings are comparable with Pamela W. Schaefer, et al. [19] in which 12 (46%) patients had lesions in the brainstem, 12 (46%) had lesions within the basal ganglia and/or thalamus, and 16 (61%) had injuries of the Corpus callosum. Compared to Ezaki Y, et al. [20] study done, among the 21 patients of DAI, grey white matter interface and central white matter involvement in 50%, Thalamus / basal ganglia involvement in 12% corpus callosum involvement in 9% and brainstem involvement in 18%. Compared to M Takaoka, et al. [21] study done, among 21 patients of DAI, involvement of corpus callosum is seen in all patients and brain stem is involved in 8 cases (38%) as per (Table 9).

Cadasil

In the present study, 3 cases (one male and 2 females) of CADASIL belonged to the age group of 35 to 44 years were observed. On MR Imaging, T2 and Flair hyper intense areas were Observed in external capsule and anterotemporal white matter in all the 3 (100%) cases. Periventricular and subcortical region was also involved in all the 3 cases (100%). Other regions involved were coronaradiate in 2 cases (66.7%), brainstem in 2 cases (66.7%). All the three cases showed

Findings	BN Lakhkar,et al. [3] study	Joost C.J Bot, et al. [17]	Prevalence in present study
Periventicular White matter (with dowson fingers)	80	100	80
Deep white matter (Brain stem)	40	96	20
Spinal cord	20	-	20
Optic nerve	20	-	20
Juxtracortical lesions	-	80	20

Table 8: Multiple sclerosis comparision of present study with existing studies.

Findings	Pamela schaefer, et al. [19]	Ezaki Y, et al. [20]	M Takaoka, et al. [21] study	Prevalence in present study
Corpus callosum	61	9%	100%	80%
Brain stem	46	-	38%	40%
Thalamus and/or basal ganglia	46	12%	-	40%
Grey white matter interface	-	50%	-	80%

Table 9: Diffuse exonal injury comparision of prasent study with exisiting studies.

Findings	Dorothe paur et al. [22] study	Vandan boom et al. [23] study	Prevalence in present study
Bilateral anterial temporal white, matter	100%	95%	100%
External capsule	-	58%	100%
Brain stem	-	-	60%
Sub cortical lacunar infacts	89.3%	37%	100%

Table 10: CADASIL comperision of present study with existing study.

subcortical infarcts. On comparison, in Doro you P. Auer, et al. [22] study, out of 28 patients on MR Imaging, all but two of the 28 patients showed involvement of temporopolar WM. Further, lesions were seen in the basal ganglia in 24 patients (85.7%), in the brainstem in 25 (89.3%), in the thalamus in 25 (89.3%), in the cerebellum in 13 (46.4%), and in the cortex in two (7.1%). Compared to Vandenboom, et al. [23] study done on 24 patients of CADASIL, Subcortical lacunar infarcts in 9 patients (37%), Lacunar infarcts 15 (62.5%), Micro bleeds (n) 4, Anterior temporal lobe 23 (95%), External capsule (n) 14 (58%) and Internal capsule (n) 15 (Table 10).

Tumefactive demyelination

Two cases of Tumefactive demyelination in our study series. Both cases were females (28 and 50 years) with average age of onset being 39 years which was comparable with D. Shah, et al. [24] who stated that these lesions occur more frequently in women in the second and third decades of life, with an average age of onset of at least 37 years. Both patients presented with gradual progressive loss of vision with one case having complete vision loss at the time of presentation. MR in both patients showed symmetrical T1 hypo intense, T2 FLAIR hyper intense lesion involving the periventricular and subcortical white matter of bilateral posterior temporal, occipital, parietal lobes extending across the splenium of corpus callosum. The lesions were showing no mass effect over the adjacent ventricular horns. On contrast administration, 2 cases showed irregular incomplete ring enhancement with open side of the ring towards the cortex. In a study by Curtis A Given, et al. [25], approximately half of tumefactive demyelinating lesions have pathologic contrast enhancement, usually in the form of ring enhancement and commonly the enhancement pattern will be in the form of an open ring, with the incomplete portion of the ring on the gray matter side of the lesionCompared to Dae Sik Kim, et al. who studied the enhancement patterns in the 15 patients with TDL reported incomplete rim enhancement was noted in 83%, Mixed T2 iso and hyper intensity of enhancing components in 83%, Absence of mass effect was noted in 79%, absence of cortical involvement was noted in 76% MRS in both the cases showed elevated lactate, reduced NAA, increased choline, elevated glutamate, reduced NAA/Ch. ratio. These findings were consistent with the study done by Curtis A Given,

et al. [25] who reported a characteristic spectrum consisting of elevated choline with suppressed levels of N-acetyl aspartate. Additionally, there may be detectable levels of lipids and lactate corresponding to necrosis and anaerobic metabolism mimicking a neoplastic process, However these lesions can be differentiated from neoplastic lesions with demonstration of glutamate peak which was noted in our cases consistent with the findings of A. Cianfoni, et al. study, who reported that an abnormal elevation of the glutamate/glutamine (2.1–2.5 ppm) peaks is the more critical MR spectroscopy finding in tumefactive lesions in the brain, a finding that is not usually seen in the confounding aggressive intra-axial neoplasms. DWI in both cases showed restricted diffusion in the periphery of the lesion with hypo intense signal in center which appeared as hyper intense center with iso to hypo intense periphery on ADC maps. These findings were consistent with the study done by C.H Toh, et al. who reported restricted diffusion in the lesion periphery was present in 7 of 8 tumefactive demyelinating lesions (87.5%) in their study group (Table 11).

Findings	Curtis A given, et al, [25] study	C.H Toh, et al. [28] study	Dae silk kim et al. [26]	Prevalence in present study
Incomplete rim enhancement	50	-	83%	100
Absence of mass effect	-	-	83%	100
Diffusion	-	87.5%	-	100

Table 11: Tumeffective demyelination- Compersition with existing studies.

Progressive multifocal leukoencephalopathy

The present study included 2 cases of PML who are HIV positive males (32 and 27 years). Krupp LB, et al. reported that PML has a stronger association with AIDS thanWith any immune suppressive disease and 55% to 85% of recent PML cases are attributable to AIDS.

The younger age of onset was consistent with the study done by Giessen VHJ, et al. on HIV patients with PML which stated that the mean age of onset was 29 years. They also opined that the mean age of onset in HIV positive cases were significantly lower than HIV sera negative PML and male patients prevailed.

MR showed well defined lesions appearing hypo intense on T1, hyper intense on T2 and FLAIR involving the subcortical white matter of bilateral frontal and right parietal lobes with no mass effect. On contrast administration, no obvious enhancing lesions were noted and no evidence of cortical atrophy. These findings correlated with the diagnostic criteria proposed by Giessen VHJ, et al.

MRS showed reduced NAA, elevated choline, normal keratinize and reduced NAA/Ch. ratio. These findings were comparable with Iranzo A, et al. and Chang L, et al. which showed PML lesions to be characterized by significantly reduced NAA, significantly increased Cho compared with control group values. DWI showed restricted diffusion in the lesion involving subcortical white matter of right frontal lobe which appeared is intense on ADC map. These findings are comparable with Bergui M; et al. study which showed newer lesions and the advancing edge of large lesions had normal-to-low ADC and gave high signal on DWI. High signal on DWI and low ADC mark the regions of active infection and cell swelling, distinguishing them from areas of reparative gliosis. The MR, MRS and DWI findings in correlation with patient's HIV status were suggestive of progressive multifocal leukoencephalopathy. In addition, our patient's CSF was positive for JC virus which supported our diagnosis.

Cerebrotendino xanthomatosis

The present study includes 2 cases of CTX. Both the patients showed symmetrical T2 hyper intensities in bilateral cerebellar hemispheres involving dentate nucleus. Cerebellar foliae are prominent with dilated fourth ventricle. Symmetrical T2 hyper intensities are noted in parieto-occipital subcortical white matter& internal capsule. Both the patients presented with cataract and achillis tendon xanthomas. These findings are consistent with Frederik Barkhof, et al. study done on 24 CTX patients in which cerebellum was affected in most patients (84%) Cerebellar involvement typically started in the dentate nucleus. The Achilles tendons were affected in seven patients. 63% cases showed pyramidal tract involvement.

Marchiafava bignami disease

Two cases of MBD were observed. Both were chronic alcoholic males of age 36 years and 22years old. T2 and FLAIR hyper intensities with diffusion restriction are noted in body and splenium of corpus callosum in both the cases. These findings are consistent with Lee SH, et al. Ménégon, et al.

Conclusion

MRI due to its excellent gray-white matter resolution is very sensitive in detecting subtle white matter changes. The present study concludes that MRI, in correlation with DWI, MRS, MR contrast in required cases is an ideal modality in early diagnosis of white matter diseases and aids in the early institution of therapy so that the curable conditions among them can be treated.

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