DOI: https://doi.org/10.53350/pjmhs20221612156

ORIGINAL ARTICLE

Prediction of Retinal Loss Based on Lesion of the Optic Nerve in Acute Stage of Optic-Neuritis

ABDUL GHAFOOR MAGSI[1], ZUHAIB AHMED SOOMRO[2], DEEPAK KUMAR[3], LAL CHAND DHINGRA[4], ISHFAQUE AHMED SIMAIR[5], NAJAM-US-SAQIB ANSARI[2]
[1]*Associate Professor, Department of Neurology, Chandka Medical College, Shaheed Mohtarma Benazir Bhutto Medical University, Larkana*
[2,3,6]*Assistant Professors,*
[4]*Associate Professor & HOD,*
[5]*Consultant Neurosurgeon, Department of Neurology, G M Mahar Medical College, Sukkur*
Correspondence to Dr. Deepak Kumar, E-mail: dr.deepakbadlani@gmail.com Cell: 0332-2732543

ABSTRACT

Aim: To assess the predictive features of optic neuritis in retinal loss through optic nerve lesion identification.
Study design: Prospectively longitudinal study
Place and duration of study: Ghulam Muhammad Mahar Medical College Sukkur and Shaheed Mohtarma Benazir Bhutto Medical University Larkana from 1st January 2021 to 30th June 2022.
Methodology: One hundred and ten patients suffering from acute optic neuritis ≤8 weeks were enrolled. Retinal optical-coherence tomography was performed in all patients. Fifty five patients in the whole cohort while clinically isolated syndrome (CIS) 25 patients and relapsing remitting multiple sclerosis (RRMS) as well as neuromyelitis-optica spectrum disorders (NMOSD) and isolated optic neuritis as 20, 3 and 7 respectively. Brain optic nerve magnetic resonance imaging which included three-dimensional double inversion recovery sequence was also conducted at acute phase (M0) and then post 12 months (M12).
Results: The mean age of the cases was 30.85±8.9 years. There was a higher frequency of males then females. The duration of the disease was found highest in RRMS cases with 50.31±77.45 months. The variance in estimated and standard error of the ganglion cell-inner plexiform layer volume change was significantly different in whole acute optic neuritis cases as well as the one with CIS and multiple sclerosisat cohort.
Conclusion: Optic nerve-lesion length in prediction of retinal-neuroaxonal loss in cases of optic neuritis. The optic-nerve lesion length can also be considered as a biomarker for the process of retinal remodeling as well as visual impairment.
Key words: Optic nerve lesion, Acute phase, Optic neuritis (ON), Retinal neuronal loss

INTRODUCTION

Acute optic neuritis is a typical and classic representation of multiple-sclerosis (MS) which is attributable towards 25% of the cases with 1st demyelinating episodes. Presentation of optic neuritis during the multiple sclerosis is observed in 70% of the cases[1]. In addition to MS the optic neuritis has also been observed as a most frequently observed manifestation of neuromyelitis optica spectrum-disorders (NMOSD) as well as myelin oligodendrocyte glycoprotein associated/linked disability or disorder (MOGAD). There have been reported studies which showed that it can also be seen with an idiopathic cause[2].

There have been few therapeutic methods which are proposed in the acute phase of optic neuritis. These strategies include corticosteroids, IV immunoglobins usage or of plasmapheresis. There have been various studies found on the efficacy timing of steroids in minimizing the long term visual impairment especially in cases of neuromyelitis-optica spectrum disorders. On the contrary there is a set of research which contraindicated and detailed no variance in long term differences in visual efficacy as a result of steroidal timings[3,4]. Lubetzki et al[5] are trying to identify a biomarker for optic neuritis new therapeutic algorithm development and optimization of optic neuritis.

The most recommended method for diagnosis of optic neuritis is considered optic nerve magnetic resonance imaging (MRI). Although it is a challenging tool yet remains the most appropriate method for diagnosis[6]. The strategy of MRI involved T2 weighted-sequence involving water as well as fat suppression.[6] The most sensitive protocol in MRI is three-dimensional inversion recovery sequencing based.[7,8] This method has been found efficient in detecting various types of lesions in optic nerve[9-11]. The present study was performed for assessing the predictive features of optic neuritis in retinal loss. The results of this study provided better and efficient management strategies which were based on substantial evidence.

Received on 26-07-2022
Accepted on 16-11-2022

MATERIALS AND METHODS

After IRB permission, this prospective longitudinal study was carried out at Ghulam Muhammad Mahar Medical College Sukkur and Shaheed Mohtarma Benazir Bhutto Medical University Larkana from 1st January 2021 to 30th June 2022. A total of 110 patients suffering from acute optic neuritis ≤8 weeks were enrolled. Each patient's consent was taken prior their participation in this study. Patients with clinical symptoms with vision loss and dyschomatopsia as important were included. Those patients having retinal pathology other than the above or were suffering from severe case of ametropia with ≥6 diopters were placed in exclusion criteria. Those patients having acute optic neuritis in their eye or already had history of optic neuritis were also excluded from the study. Abnormal neuro-ophthalmologic assessments as well as of visual fields was made. Patients were followed up to 12 months. All clinical, demographic and details of each patient were completely documented. The clinical diagnosis of acute optic neuritis was made through various test and radiological imaging. Retinal optical-coherence tomography (OCT) was performed in all patients. Brain optic nerve magnetic resonance imaging (MRI) which included three-dimensional double inversion recovery sequence was also conducted at acute phase (M0) and then post 12 moths (M12). The primary outcomes of the study were measured through hypersignal-lesion length of optic-nerve three-dimensional double inversion recovery sequence as well as ganglion cell-inner plexiform layer (GCIPL) which was measurable on OCT. Low contrast-monocular-visual acuity (LCMVA) was also conducted for primary outcomes. Data was analyzed by using SPSS version 26.0. Chi square test was applied where p value <0.05 was taken significant.

RESULTS

The mean age of the cases was 30.85±8.9 years. There was a higher frequency of males in the participant then females. The duration of the disease was found highest in RRMS cases with 50.31±77.45 months (Table 1).

The MRI of patient's optic nerve with CIS showed left acute phase of optic neuritis. Patients when enrolled had no lesion was presented at the right side optic nerve. However, at the month 12 (M12) a novel onset of asymptomatic retrobulbar nerve optics with DIR hyper-signal was found (Fig 1).

The variance in estimated and standard error of the GCIPL volume change was significantly different in whole acute optic neuritis cases as well as the one with CIS and MS at cohort. Inner nuclear layer (INL) volume change was significantly related between estimated and standard error in whole acute optic neuritis cases and also in CIS and MS (Table 2).

The symptomatic optic-nerve double inversion recovery(DIR) hyper-signal were assessed and was found that in RRMS patients 1st right optic neuritis episode was suspected, however later no optic nerve lesion was detected with stable thickness of GCIPL during the follow-up (Fig. 2).

Fig. 1: MRI results of optic nerve detecting new and asymptomatic optic never lesion

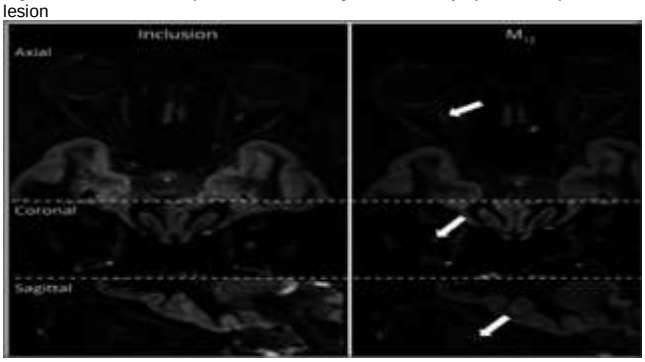


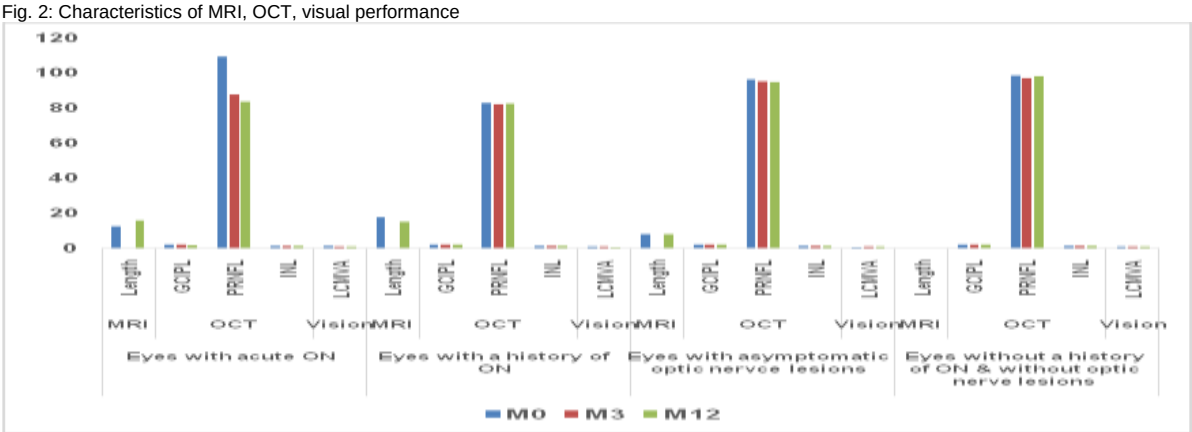
Table 1: Demographic characteristics and duration of disease

Variables	Whole Cohort	Patients Groups			
	All (n=55)	CIS (n=25)	RRMS (n=20)	NMOSD (n=3)	Isolated ON (n=7)
Gender					
Male	33 (60%)	19 (76%)	10 (50%)	3 (100%)	4 (57.1%)
Female	24 (43.6%)	6 (24) (76)	10 (50)	-	3 (42.85%)
Age (years)	32.44±7.8	33.42±8.12	21.3±7.35	35.52±16.12	31.6±5.3
Duration of Disease in months	20.95±54.11	0.35±0.45	50.31±77.45	0.50±0.59	8.85±19.75
History of Optic neuritis	7 (12.72%)	-	4 (20%)	-	2 (28.57%)
Under Fingolimod at inclusion	3 (5.45%)	-	2 (10%)	-	-
Under Fingolimod at M12	6 (10.9%)	-	5 (25%)	-	-

Table 2: comparison of GCIPL and INL volume and pRNFL thickness in whole and CIS+MIS cases

Variables	Whole acute ON eyes cohort (n=55)			Acute ON eyes cohort of CIS and MS (n=45)		
	Estimated	±SE	P value	Estimated	±SE	P value
GCIPL volume change	-0.011	0.004	0.0017	-0.014	0.005	0.0012
pRNFL thickness change (µm) at M_{12}	+0.035	0.157	0.83	-0.025	0.153	0.87
INL volume change (mm^3)	+0.002	0.001	0.02637	+0.002	0.001	0.0845
LCMVA 2.5 at M12	+0.017	0.004	0.0001	+0.015	0.005	0.0055

Fig. 2: Characteristics of MRI, OCT, visual performance



DISCUSSION

The present study was conducted to assess the association of optic nerve lesion length and acute optic neuritis with the structural and functional visual parameters included in the study. The current study asserted the significance of the length of the optic nerve lesion in predicting retinal-neuroaxonal loss in cases of optic neuritis. The length of the optic nerve lesion may be used as a biomarker in the retinal remodelling procedure and the impairment of visual fields[12-14].

The lengthening of the optic-nerve lesion is directly related to the reduction of the GCIPL, as well as thickening of the INL and chronic visual impairment. The thickening of the INL is a common symptom of post-optic neuritis, which is linked to the MME in severe cases[15].

The MME is testified to in nearly 4% of the cases having RRMS as well as in 20% of the cases with NMOSD[16]. A similar result has been reported in the current study. However, the association of pRNFL thinning is not found to be related to the length of the optic-nerve lesion.[17,18] There is literature available that confirms this. Optic neuritis is characterised by large to subtle swelling of the optic nerve.[19,20]

The fact that GCIPL thinning has been related to the early representation of the optic neuritis. Majority of thinning of GCIPL occurs in first two months, with short-term visual impairment predicted in first month[21,22]. Current research results interpret similar findings.

CONCLUSIO

Optic-nerve lesion length in prediction of retinal-neuroaxonal loss in cases of with optic neuritis was found. Length of optic nerve lesion can be considered biomarker for retinal-remodelling procedure and also in cases of visual impairment.

Conflict of interest: Nil

REFERENCES

1. Toosy AT, Mason DF, Miller DH. Optic neuritis. Lancet Neurol 2014;13(1):83-99.
2. Petzold A, Wattjes MP, Costello F, Flores-Rivera J, Fraser CL, Fujihara K, et al. The investigation of acute optic neuritis: a review and proposed protocol. Nat Rev Neurol 2014;10(8):447-58.
3. Akaishi T, Takeshita T, Himori N, Takahashi T, Misu T, Ogawa R, et al. Rapid administration of high-dose intravenous methylprednisolone improves visual outcomes after optic neuritis in patients with AQP4-IgG-positive NMOSD. Front Neurol 2020;11:932.
4. Kleiter I, Gahlen A, Borisow N, Fischer K, Wernecke KD, Wegner B, et al. Neuromyelitis optica: evaluation of 871 attacks and 1,153 treatment courses. Ann Neurol 2016;79(2):206-16.
5. Lubetzki C, Zalc B, Williams A, Stadelmann C, Stankoff B. Remyelination in multiple sclerosis: from basic science to clinical translation. Lancet Neurol 2020;19:678-88.
6. Kolappan M, Henderson AP, Jenkins TM, Wheeler-kingshott CA, Plant GT, et al. Assessing structure and function of the afferent visual pathway in multiple sclerosis and associated optic neuritis. J Neurol 2009;256(3): 305-19.
7. Hodel J, Outteryck O, Bocher AL, Bocher AL, Zephir H, Lambert O, et al. Comparison of 3D double inversion recovery and 2D STIR FLAIR MR sequences for the imaging of optic neuritis: pilot study. Eur Radiol 2014;24(12):3069-75.
8. Sartoretti T, Sartoretti E, Rauch S, Binkert C, Wyss M, Czell D, et al. How common is signal-intensity increase in optic nerve segments on 3D double inversion recovery sequences in visually asymptomatic patients with multiple sclerosis? Am J Neuroradiol 2017;38(9):1748-53.
9. London F, Zéphir H, Drumez E, Labreuche J, Hadhom N, Lannoy J, et al. Optical coherence tomography: a window to the optic nerve in clinically isolated syndrome. Brain 2019;142(4):903-15.
10. Hadhoum N, Hodel J, Defoort-Dhellemmes S, Duhamel A, Drumez E, Zephir H, et al. Length of optic nerve double inversion recovery hypersignal is associated with retinal axonal loss. Mult Scler 2016;22(5):649-58.
11. Davion JB, Lopes R, Drumez É, Labreuche J, Hadhoum N, lannoy J, et al. Asymptomatic optic nerve lesions: an underestimated cause of silent retinal atrophy in MS. Neurology 2020;94(23):e2468-78.
12. Outteryck O, Vermersch P.OCT findings in neuromyelitisoptica spectrum disorders. In: Petzold A, ed.Optical Coherence Tomography in Multiple Sclerosis. Springer international Publishing 2016; 85-96.
13. Kupersmith MJ, Alban T, Zeiffer B, Lefton D. Contrast-enhanced MRI in acute optic neuritis: relationship to visual performance. Brain 2002;125(pt 4):812-22.
14. Beck RW, Cleary PA, Anderson MM Jr, Keltmer JL, Shults WT, Kaufman DL, et al. A randomized, controlled trial of corticosteroids in the treatment of acute optic neuritis. N Engl J Med 1992;326(9):581-8.
15. Outteryck O, Lopes R, Drumez É, Labruche J, Lannoy J, Hadhoum N, et al. Optical coherence tomography for detection of asymptomatic optic nerve lesions in clinically isolated syndrome. Neurology 2020;95(6):e733-44.
16. Saidha S, Syc SB, Durbin MK, Eckstein C, Oakley JD, Meyer SA, et al. Visual dysfunction in multiple sclerosis correlates better with optical coherence tomography derived estimates of macular ganglion cell layer thickness than peripapillary retinal nerve fiber layer thickness. Mult Scler 2011;17(12):1449-63.
17. Gabilongo I, Martinez-Lapiscina EH, Fraga-Pumar E, et al. Dynamics of retinal injury after acute optic neuritis. Ann Neurol 2015;77:517-28.
18. Jenkins TM, Toosy AT, Ciccarelli O, Miszkeil KA, Wheeler-Kingshott CA, Henderson AP, et al. Neuroplasticity predicts outcome of optic neuritis independent of tissue damage. Ann Neurol 2010;67(1):99-113.
19. Kapoor R, Miller DH, Jones SJ, Plant GT, Brusa A, Gass A, et al. Effects of intravenous methylprednisolone on outcome in MRI-based prognostic subgroups in acute optic neuritis. Neurology 1998;50(1):230-37.
20. Sartoretti T, Stürmer J, Sartoretti E, Najafi A, Schwenk A, Wyss M, et al. Long segment 3D double inversion recovery (DIR) hypersignal on MRI in glaucomatous optic neuropathy. BMC Ophthalmol 2019;19(1):258.
21. Blanc C, Heran F, Habas C, Bejot Y, Sahel J, Vignal-Clermont C.MRI of the optic nerves and chiasm in patients with leber hereditary optic neuropathy. J Neuroophthalmol 2018;38(4):434-7.
22. Stunkel L, Kung NH, Wilson B, McClelland CM, Van Stavern GP. Incidence and causes of over diagnosis of optic neuritis. JAMA Ophthalmol 2018;136(1):76-81.