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Evaluation of the Detection Accuracy of Conventional Magnetic Resonance Imaging in Patients Diagnosed with Optic Neuritis

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Abstract **Introduction:** Inflammation of the optic nerve is one of the most common causes of unilateral and/or bilateral blindness. The most common cause of this phenomenon is demyelinating processes which involve central nervous system and the diagnosis is suspected via clinical finding and confirmed by Magnetic Resonance Imaging (MRI). In this study we plan to investigate whether isolated conventional MRI is a reliable and sufficient diagnosing tool in approach to patients with clinical finings of optic neuritis. **Methods:** This retrospective study was performed in patients referred to neurology department of a private hospital in Tehran from 2012 to 2014, and underwent brain MRI after clinical diagnosis has been established. Clinical diagnosis of optic neuritis was confirmed by neuro-ophthalmological examination, visual field assessment and visual evoked potential (VEP). We have utilized SPSS program for statistical analysis, along with Student T-test and Chi-Square test. **Result:** Demographic analysis and data gathering were performed for all of the patients. Ninety patients were enrolled in the study, which 58 cases (64.4%) showed MRI abnormality in their neuro-imaging. In this group, supratentorial and infratentorial lesions were existed in 34 cases (58.6%) and 24 cases (41.3%) respectively. The most common affected sites of supratentorial region were periventricular region (in 17 cases), followed by juxtacortical (in 6 cases), basal ganglia (in 3 cases), corpus callosum (in 3 cases), centrum semiovale (in 2 cases) and in optic nerve in 3 patients. In patients with lesions in their infratentorial region, the most common sites were cerebellum hemispheres (in 11 cases), followed by mesencephalon (in 6 cases), pons (in 4 cases) and medulla oblongata (in 3 cases). **Conclusion:** We have found that conventional MRI as a single approach is not reliable in detecting enhancing plaques of white matter tracts in 35.6% of our enrolled cases who their diagnosis of optic neuritis were confirmed by visual field assessment and VEP. This issue raises the importance of addition of other enhancing technique to MRI for better localization of enhancement for multi-disciplinary approach.

Keywords: *optic neuritis, Magnetic Resonance Imaging, neuro-imaging*

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1. Introduction

Optic neuritis is the demyelinating inflammation of the optic nerve (cranial nerve II) which is commonly seen in patients suffering from multiple sclerosis (MS) and neuromyelitis optica (NMO). Most commonly, optic neuritis complicate these patients in their young adulthood; however, isolated optic neuritis in the absence of an underlying neurological disease is described in the literature. In some instances, infection of the adjacent structures such as paranasal sinuses or orbital fossa may cause optic neuritis. [1] Also, distant distribution of micro-organisms in sepsis state or in instances such as infective endocarditis, may result in optic neuritis. [2] This phenomenon affects Caucasians more than other races, as well as women more than men (2 to 3 times) mostly in their 2^{nd} to 4^{th} decade. [3] Most patients experience dull eye pain which may progress to acute attack phase manifested as rapidly deteriorating visual acuity in the affected eye, and less commonly, in both eyes based on underlying neurologic disease. [4] Optic neuritis is suspected in patients with recent decreased visual acuity, red/green dyschromatopsia and ocular pain, and is confirmed by further studies such as visual field assessment and visual evoked potential (VEP) as centrocecal scotoma and reduced amplitude/latency respectively. Moreover, neuro-imaging by Magnetic Resonance Imaging (MRI) is the preferred method for further evaluation of central nervous system for enhanced localization of the lesions and exclusion of other possible diagnosis. [5] In this study, authors plan to investigate whether isolated conventional MRI is a reliable and

sufficient diagnosing tool in approach to patients with clinical finings of optic neuritis.

2. Methods

From 2012 to 2014, patients who exhibit neuro-ophthalmological manifestation of optic neuritis referred to neurology clinic in a private hospital in Tehran. In this retrospective study, authors have recorded demographic data including age, sex, thorough neurological examination, visual field assessment and VEP. Clinical diagnosis of optic neuritis was confirmed using neuro-ophthalmological examination, patient's signs and symptoms and their visual field and VEP data. Patients underwent T1 and T2-weighted brain MRI for further assessment. Patients with underlying neurological active disease, history of radiation therapy, history of cranial malignancies and metastasis to central nervous system were excluded from the study. Also, due to high probability of altered resonance secondary to vascular changes in MRI, patients with history of active underlying collagen vascular diseases with trend to involve cerebrovasculature and patients with advanced age (more than 70) due to atherosclerosis of cerebrovasculature and patients with infections of central nervous system were excluded from study. Patients who signed informed consent form based on ethical committee of ministry of health of Iran were enrolled in the study.

3. Results

After exclusion, 90 patients with mean age of 31.2 years were enrolled in the study. Demographic data gathering revealed female population as 66 cases (73.3%) with mean age of 30.1 years (ranged between 19.2-47.8 years) and males as 24 cases (26.6%), with mean age of 35.4 years (ranged between 26.7-42.4 years). (P value=0.102) Visual field impairment such as central scotoma, para-central scotoma and centro-cecal scotoma, as well was observed in 87.8% and 87.5% of females and males, respectively. Also, VEP study revealed decreased amplitude in 81.8% and 70.8% of females and males, respectively. Of this cases, 39 patients were diagnosed with MS, 22 patients suffered from vascular complications which causes optic neuritis such as anterior ischemic optic neuropathy, 15 patients suffered from infectious complications of adjacent structures which causes optic neuritis, 11 patients were diagnosed with NMO and 3 cases were diagnosed with isolated optic neuropathy (possible hereditary). Of these 90 cases, 58 cases (64.4%) showed MRI abnormality in their neuro-imaging. In this group, supratentorial and infratentorial lesions were existed in 34 cases (58.6%) and 24 cases (41.3%) respectively. The most common affected sites of supratentorial region were periventricular region (in 17 cases), followed by juxtacortical (in 6 cases), basal ganglia (in 3 cases), corpus callosum (in 3 cases), centrum semiovale (in 2 cases) and in optic nerve in 3 patients. In patients with lesions in their infratentorial region, the most common sites were cerebellum hemispheres (in 11 cases), followed by mesencephalon (in 6 cases), pons (in 4 cases) and medulla oblongata (in 3 cases).

4. Discussion

Most of the cases suffered from optic neuritis have concurrent diagnosis of MS, however, optic neuritis may occur in isolation. In patients suffering from MS, monosymptomatic optic neuritis as a result of autoimmune inflammatory demyelination of optic nerve occurs. Histopathologic studies suggest the similar nature of lesions to cerebral plaques in patients diagnosed with MS. [6] However, simultaneous presence of myelitis and optic neuritis which is manifested on spinal MRI, is in favor of NMO. Patients with NMO have circulating NMO IgG antibody which targets water channel aquaporin-4. [7] A study revealed that bilateral optic neuritis in childhood reduces the possibility of progression to MS. [8] A gradual recovery of visual acuity is the characteristic of optic neuritis from 1 week to several weeks after disease initiation. The chance of visual acuity recovery is less in patients with underlying MS who have cerebral lesions showed in brain MRI. [9] Pupillary light reaction is decreased in the affected eye and a relative afferent pupillary defect (RAPD) or Marcus Gunn pupil commonly is found. In bilateral cases, the RAPD may not be apparent. [10] There are several conditions associated with optic neuritis which should be considered including NMO, hereditary optic neuropathies, nutritional optic neuropathies, granulomatosis with polyangiitis, necrotizing herpetic retinopathy in immune-compromised, branch retinal artery occlusion, central retinal artery occlusion, herpes simplex and functional vision loss. Although, several conditions should be kept in mind in differential diagnosis list, such as anterior complications of sarcoidosis, anterior ischemic optic neuropathy, compressive optic neuropathy, acute angle-closure glaucoma, interstitial keratitis, optic nerve sheath meningioma, sudden visual loss, thyroid ophthalmopathy and toxic optic neuropathy. [11] Conventional MRI is highly sensitive and specific modality in assessment of optic neuropathy. Occasionally findings are most easily identified in the retrobulbar intra-orbital segment of the optic nerve, which appears swollen, with high T2 signal. [12,13] Also, contrast enhancement of optic nerve sheet is best appreciated via fat-suppressed T1-coronal images. Although, our study revealed that in patients who were clinically diagnosed with optic neuritis, only a minority of patients exhibited isolated optic nerve enhancement, while plaque-type enhancement is observed in other parts of the central nervous system [14,15] We have found that although most of the patients with clinical diagnosis of optic neuritis were confirmed by visual field assessment and VEP, conventional MRI is incapable of detection of enhancing plaques of white matter tracts in 35.6% of our enrolled patients. This issue raises the importance of addition of other enhancing technique to MRI for better localization of enhancement for multi-disciplinary approach.

5. Conclusion

We have found that conventional MRI as a single approach is not reliable in detecting enhancing plaques of white matter tracts in 35.6% of our enrolled cases who their diagnosis of optic neuritis were confirmed by visual

field assessment and VEP. This issue raises the importance of addition of other enhancing technique to MRI for better localization of enhancement for multi-disciplinary approach.

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