Coll. Antropol. **29** (2005) 2: 633–636
UDC 617.731-002-036.2:616.832
Original scientific paper

The Correlation of Changes of the Optic Nerve Diameter in the Acute Retrobulbar Neuritis with the Brain Changes in Multiple Sclerosis

Marina Titlić[1], Ivana Erceg[2], Tanja Kovačević[3], Nikica Gabrić[4], Ksenija Karaman[5], Igor Žuljan[5], Krešimir Oršolić[6] and Josip Kalajžić[7]

[1] Department of Neurology, Universty Hospital Split, Split, Croatia
[2] Laboratory for Clinical and Forensic Genetics, University Hospital Split, Split, Croatia
[3] General Practice »Dugi Rat«, Dugi Rat, Croatia
[4] Institute for Ophthalmology, General Hospital »Sveti Duh«, Zagreb, Croatia
[5] Department of Ophthalmology, University Hospital Split, Split, Croatia
[6] Institute for Radiology, General Hospital »Sveti Duh«, Zagreb, Croatia
[7] Kalajžić Diagnostic Center, Split, Croatia

A B S T R A C T

The aim of this paper is to compare diameter of healthy and affected optic nerve determined by ultrasound with brain lesions in acute retrobulbar neuritis in patients with multiple sclerosis. In this prospective study 20 patients with multiple sclerosis and acute retrobulbar neuritis were examined. Optic nerve diameter was measured by ultrasound. Brain lesions were detected by magnetic resonance. Correlation between demyelinating lesions of the brain in multiple sclerosis and optic nerve diameter was tested by Kruskal-Wallis test. Significant difference in diameter between healthy and affected optic nerve in acute retrobulbar neuritis was found. Demyelinating brain changes examined by magnetic resonance revealed periventricular lesions, subcortical lesions and lesions in corpus callosum. There is statistically significant correlation between optic nerve diameter and number of brain lesions in multiple sclerosis, $p<0.05$. Diameter of optic nerve in retrobulbar neuritis measured by ultrasound correlates with brain lesions detected by magnetic resonance in multiple sclerosis.

Key words: *optic nerve, retrobulbar neuritis, multiple sclerosis, ultrasound, magnetic resonance*

Introduction

Multiple sclerosis (MS) is remittent chronic disease characterized by demyelinating plaques, spread through cerebral white matter lesions[1]. MS is one of the most frequent neurological disorders[2] with different etiological factors: genetic, immunological, environmental, infectious, stress factors and others. Many others neurological diseases can mimic clinical features of MS. Most patients who develop clinically definite MS following an initial episode of optic neuritis will have a relatively benign course for at least 10 years. Retrobulbar neuritis (RN) has incidence of 62% in MS[3].

There is no specific laboratory test for MS diagnosis. Clinical characteristics, magnetic resonance imaging (MRI) pattern of abnormalities, evoked potential studies and cerebrospinal fluid oligoclonal band analysis are of high diagnostic yield in late onset MS patients, but expertise in interpreting their results is strongly required[1].

McDonald's criteria for MS were established based on different diagnostic procedures[4].

MRI is most indicative method for evaluation and clinical follow-up of MS. In case that MRI detects demyelinating lesions of cerebral white matter 5-year-risk for MS development is 60% and if there is no MRI confirmation risk is only 5%[5].

Four-parameter dichotomized MRI model including gadolinium-enhancement, juxtacortical, infratentorial

Received for publication October 4, 2004

and periventricular lesions best predicts conversion to clinically definite multiple sclerosis. Lesions detected by MRI can be classified according to size and number additionally to localization. Frederiksen quantification based on size and number of the lesions revealed by MRI is most accepted classification[6].

MRI is, however, valuable for differential diagnosis of RN in MS and RN caused by optic nerve tumor; nicotine-alcohol based visual loss and benign intracranial hypertension[7].

RN diagnosis is achieved by anamnesis, extensive ophthalmologic examination, laboratory tests, MRI and visual evoked potentials.

Ultrasound examination of the optic nerve can be performed with A-scan and B-scan method. A-scan method is most sensitive method for detection of the optic nerve damage, and is precise for measurement of optic nerve thickness. Normal thickness of the optic nerve is 2.4–3.4 mm and diameter difference larger than 0.3 mm in two eyes of the same person is considered pathological[8].

There is still unknown mechanism how demyelinating plaques influence optic nerve diameter changes in patients with acute RN in MS.

Purpose of this prospective study was to investigate correlation between optic nerve diameter changes measured by ultrasound A-scan method with the cerebral white matter demyelinating lesions detected by MRI in patients with MS who had first attack of RN.

Patients and Methods

In this research 20 patients 17 to 35 years old with average age of 25.7 were studied. There were 7 male (35%) and 13 female (65%). All of them fulfilled McDonald's criteria for MS and they had first attack of RN. RN was confirmed by clinical course: pain during eye movement, visual acuity decrease, narrowing of visual field, and color vision disturbances.

Optic nerve diameter was determined by ultrasound A-scan method. Nidec Echo-Scan US 3000 Ltd was used with 10 MHz tube, canton, MA, USA, 1995. Measurements were performed during the first two or three days after initial symptoms because after that time usually corticosteroid regimen is applied and it can interfere with results.

MRI detected lesions of the white brain matter. General Electric Max Plus 0.5 T New York, USA, 1995 and Hitachi 0.2 T, Twinsburg, Ohio, USA, 1989, were used. Lesions were divided according to localization in periventricular lesions, subcortical lesions, lesions of corpus callosum and others. Lesions were classified by Frederickžs classification.

Statistical analysis

Qualitative data was analyzed with frequency tables. Quantitative data was described by arithmetic midpoint, standard deviation and centile distribution.

Correlation between qualitative data is shown with contingency tables. Correlation between quantitative variables was analyzed by Kruskall-Wallis test. The level of significance was set at $p<0.05$.

Results

Ultrasound examination showed that optic nerve diameter of the eye with RN is 0.6 mm larger than optic nerve diameter of the healthy eye (Table 1).

TABLE 1
ARITHMETIC MIDPOINT OF OPTIC NERVE DIAMETER COMPARED WITH RETROBULBAR NEURITIS AND ARITHMETIC MEAN OF DIAMETER OF HEALTHY NERVE

Ultrasound diameter	Aritmethic midpoint	SD	Min	Max	Median
Healthy nerve	3.6	0.6	2.9	4.7	3.5
Affected nerve	4.2	0.7	3.0	5.4	4.2
Difference	0.6	0.4	0.1	1.5	0.6

Min – minimum, Max – maximum

Demyelinating lesions of the brain detected by MRI according to localization revealed that all patients had periventricular lesions. Subcortical lesions had 70% of examined patients while 10% had lesions in corpus callosum.

Number and size of the lesions were ordered by Frederiksen quantification (Table 2).

TABLE 2
FREDERIKSEN QUANTIFICATION OF DEMYELINATING LESIONS DETECTED BY MRI IN PATIENTS WITH RETROBULBAR NEURITIS AND MULTIPLE SCLEROSIS

Frederiksen quantification (degree)	Number of lesions	Diameter of lesions (mm)	Number of patients (%)
1.	2–6	≤ 6	4 (20%)
2.	7–15	≤ 6	2 (10%)
3.	2–15	≤ 15	6 (30%)
4.	16–25	≤ 15	2 (10%)
5.	≥26	≤ 15	4 (20%)
6.	≥1	> 15	2 (10%)

Majority of the patients had 2–15 lesions with size equal or less than 15 mm. There was no significant correlation between Frederiksen quantification in gender, painfulness in eye during rest and eye movement.

Connection between brain lesions and visual acuity in patients with RN was obtained by Kruskall-Wallis test and it revealed statistically significant correlation with $p<0.05$ (Table 3).

Optic nerve diameter measured by ultrasound in correlation with brain lesions detected by MRI showed sta-

TABLE 3
VISUAL ACTIVITY AND FREDERIKSEN QUANTIFICATION

	Frederiksen quantification	1.	2.	3.	4.	5.	6.
		N (%)					
Visus activity	0.01–0.09	0 (0%)	2 (10%)	0 (0%)	0 (0%)	0 (0%)	2 (10%)
	0.1–0.3	0 (0%)	0 (0%)	4 (20%)	2 (10%)	0 (0%)	0 (0%)
	0.6–0.8	2 (10%)	0 (0%)	2 (10%)	0 (0%)	2 (10%)	0 (0%)
	light perception	2 (10%)	0 (0%)	0 (0%)	0 (0%)	2 (10%)	0 (0%)

$p<0.05$

tistically significant result with $p<0.05$ both when healthy eye and eye affected by RN optic nerve diameter was measured and compared with MRI distinguished brain lesions.

Discussion

Retrobulbar neuritis is present in 40% of all patients with MS[9]. It is very important for MS diagnosis, clinical follow-up and prognosis to acquire as more information as we can to achieve better outcome. According to relevant literature diameter of the optic nerve with RN enlargement in comparison with healthy optic nerve is significant if difference is more than 0.3 mm[10].

Results presented in this research showed significant difference of 0.6 mm.

MRI especially during or following a first attack, can be helpful in providing evidence of lesions in other parts of the brain and spinal cord. MRI has significantly extended the understanding of MS, owing to its ability to sensitively depict the dynamics of the disease process in vivo[1,7]. Demyelinating lesions obtained with MRI are usually found in periventricular region, subcortical region and in corpus callosum[11,12], and results of this study confirmed these findings.

There was no data previously reported in the literature any data about correlation between diameter difference of the optic nerve measured by ultrasound and MRI detected brain lesions in MS patients with acute attack of RN.

In this research was found statistically significant correlation between optic nerve diameter in RN measured by ultrasound and number of lesions detected by MRI analyzed by Kruskal-Wallis test. There was also significant correlation between healthy optic nerve diameter measured by ultrasound and brain lesions detected by MRI.

In conclusion, ultrasound measurement of the optic nerve is very valuable and straightforward method for RN diagnosis in MS because enlargement of the optic nerve diameter correlates significantly with MRI obtained lesions in patients with MS.

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I. Erceg

Selska 7, 10000 Zagreb, Croatia
e-mail: ivana.erceg@st.htnet.hr

KORELACIJA PROMJERA VIDNOG ŽIVCA U AKUTNOM RETROBULBARNOM NEURITISU I MOŽDANIH PROMJENA KOD MULTIPLE SKLEROZE

S A Ž E T A K

Cilj ovog rada je usporediti promjere zdravog i bolesnog vidnog živca mjerene ultrazvukom sa moždanim lezijama u akutnom retrobulbarnom neuritisu kod multiple skleroze. Ispitivano je 20 bolesnika koji boluju od multiple skleroze i imali su retrobulbarni neuritis. Promjer vidnog živca je mjeren ultrazvukom. Moždane lezije su otkrivene sa magnetskom rezonancom. Korelacija između demijelinizirajućih lezija mozga u multiploj sklerozi i promjera vidnog živca je testirana sa Kruskal-Wallisovim testom. Nađena je značajna razlika između promjera zdravog i bolesnog optičkog živca u retrobulbarnom neuritisu. Demijelinizirajuće promjene mozga ispitivane magnetskom rezonancom detektirane su u periventrikularnom i subkortikalnom području, te u korpusu kalozumu. Nađena je statistički značajna korelacija između promjera vidnog živca i broja moždanih lezija kod multiple skleroze, $p<0.05$. Promjer vidnog živca u retrobulbarnom neuritisu mjeren sa ultrazvukom korelira sa lezijama mozga detektiranim sa magnetskom rezonancom kod multiple skleroze.