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Magnetic Resonance Imaging of the Brain in Nonarteritic Ischemic Optic Neuropathy

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We wished to determine whether the number of central nervous system (CNS) white matter lesions on magnetic resonance imaging (MRI) is increased in patients with nonarteritic ischemic optic neuropathy (NAION). T_2-Weighted axial images of the brain in 13 patients with acute NAION and 16 age-matched controls were used to tabulate the number of subcortical and periventricular white matter lesions. Groups were compared by t test for means, the Wilcoxon-Mann-Whitney rank-sum test, and chi-square test for proportions with at least one lesion. The mean number of CNS white matter ischemic lesions in the NAION group was 4.0 (range 0–20) as compared to 1.4 (range 0–7) in the control group. The difference in these samples suggested a significant increase in NAION ($p = 0.069$, rank-sum test). The proportions of patients with at least one lesion were not significantly different (53.8% NAION vs. 56.3% controls). The data suggest an increased number of CNS white matter lesions in patients with NAION.
Key Words: Ischemic optic neuropathy—Magnetic resonance imaging—CNS white matter lesions.

Nonarteritic anterior ischemic optic neuropathy (NAION) is presumed to result in part from microvascular insufficiency in the optic nerve head (1) and is purportedly associated with increased risk of cerebrovascular and cardiovascular disease (2–4). Subcortical white matter lesions on magnetic resonance imaging (MRI) are frequently observed in scans of the elderly and in such instances are believed to reflect small vessel cerebrovascular disease (5). We compared MRI scans of the brain in patients with acute NAION with those of age-matched controls to determine whether the number of CNS white matter lesions is increased in patients with this disorder.

PATIENTS AND METHODS

MRI of the brain was performed in 13 patients with acute NAION examined at the Jules Stein Eye Institute from 1989 to 1994. All patients were aged ≥45 years, with recent (≤30 days) onset of monocular visual loss and the presence of an afferent pupillary defect, optic disc swelling, and visual field loss consistent with NAION. No patients had evidence of previous visual loss in the same eye, systemic symptoms suggestive of vasculitis (including temporal arteritis) or demyelinating disease, or Westergren sedimentation rate >40 mm/h. Eleven patients were men and two were women, with a mean age of 61.2 years (range 48–71 years). Eight patients (61.5%) were hypertensive, and one (7.6%) was diabetic. None had had previous stroke.

MRI scan was performed in seven patients with NAION on a 1.5-T superconductive unit (Signa, General Electric, Medical Systems Division, Milwaukee, WI, U.S.A.) and in six on an 0.3-Tesla permanent magnet unit (Fonar, Melville, NY, U.S.A.), both with a 256 × 192 matrix. T_2-

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Weighted [repetition time (TR) = 2,200 ms Signa, 3,000 ms Fonar, echo time (TE) = 80 ms Signa, 85 ms Fonar] axial images (5 mm thickness, 2.5-mm gaps) were evaluated for the number of subcortical and periventricular white matter lesions present (Fig. 1).

Sixteen control patients matched for age and incidence of systemic hypertension and diabetes, with no previously diagnosed central nervous system (CNS) disease and otherwise negative MRI scans, were used for comparison. Controls were selected on the basis of quality of images of the brain from 29 patients in the same population (ACA clinical practice) who underwent imaging at UCLA Medical Center from 1991 to 1994. Nine patients were men and seven were women, with a mean age of 62.8 years (range 48–81 years). Nine (56.3%) were hypertensive, and two (12.5%) were diabetic; none had had previous stroke. All studies were accomplished on the 1.5-Tesla superconductive unit (Signa) with the same imaging parameters as those selected for NAION patients. Similar analysis of white matter lesions was performed.

Patients with NAION were compared with controls for number of white matter lesions by Student's t test for means and the Wilcoxon-Mann-Whitney rank-sum test. Proportions of patients with at least one lesion were compared between groups by the chi-square test.

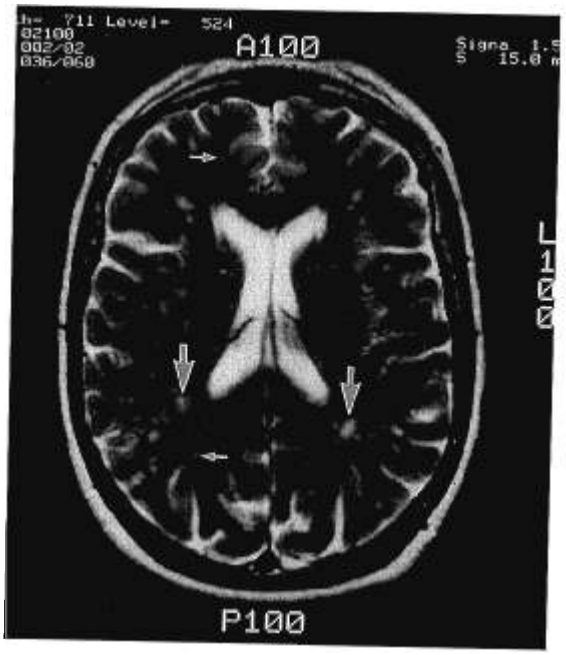

FIG. 1. T_2-Weighted axial magnetic resonance imaging scan of brain in patient with nonarteritic anterior ischemic optic neuropathy (patient 9), shows typical white matter lesions (large arrows). Smaller, smoothly rounded densities (small arrows) probably represent perivascular spaces and were not tabulated.

RESULTS

Patient data are summarized in Tables 1 and 2. The mean number of lesions in the NAION group was 4.0 (range 0–20, SD ± 5.97) as compared to 1.4 (range 0–7, SD ± 2.13) in the control group, suggesting but not statistically confirming an increase in the NAION group ($p = 0.143$, t test). Comparison by the Wilcoxon-Mann-Whitney rank-sum test was more suggestive of an increased number of lesions in NAION ($p = 0.069$). Seven (53.8%) of 13 patients with disease demonstrated at least one lesion, as compared to nine (56.3%) of 16 controls ($p = 0.897$, chi-square test), an insignificant difference.

DISCUSSION

T_2-Weighted MRI of the brain demonstrates subcortical and periventricular white matter lesions in a significant number of elderly patients with no known CNS disease (5). Patients with hypertension, diabetes, cardiovascular, and cerebrovascular disease have an increased incidence of such lesions, which are believed to represent focal perivascular ischemic demyelination and gliosis (6). The degree of involvement with these foci may be an index of cerebrovascular disease (5).

NAION has also been associated with vasculopathic risk factors (2–4) and presumably reflects microvascular disease of the optic nerve head (1). Jay and Williamson (7) compared nine patients with NAION with 11 controls for the number of subcortical white matter lesions, finding an increased number in patients with disease and a suggestive but not statistically significant difference in means (3.2 lesions in NAION vs. 0.9 in controls, $p = 0.08$, t test). The proportion of control patients

TABLE 1. *Clinical profile and MRI findings in 13 patients with NAION*

Patient/age (yr)/sex	HTN/DM	No. of lesions
1/64/M	−/+	0
2/52/F	+/−	5
3/69/M	+/−	10
4/56/M	+/−	0
5/60/M	−/−	0
6/70/M	+/−	2
7/70/M	+/−	9
8/61/M	+/−	0
9/61/F	+/−	20
10/48/M	−/−	0
11/71/M	−/−	5
12/64/M	+/−	0
13/49/M	−/−	1

MRI, magnetic resonance imaging; NAION, nonarteritic anterior ischemic optic neuropathy; HTN, hypertension; DM, diabetes mellitus.

TABLE 2. *Clinical profile and MRI findings in 16 control patients*

Control/age (yr)/sex	HTN/DM	No. of lesions
1/51/M	+/−	2
2/69/M	+/−	0
3/71/F	−/−	2
4/64/M	+/+	7
5/49/M	−/−	6
6/67/M	+/−	0
7/48/M	−/−	0
8/81/M	+/−	1
9/72/M	+/−	1
10/61/F	−/−	0
11/70/F	+/+	0
12/63/F	+/−	1
13/51/F	−/−	0
14/61/F	−/−	0
15/73/F	+/−	1
16/53/M	−/−	1

MRI, magnetic resonance imaging; HTN, hypertension; DM, diabetes mellitus.

with hypertension, diabetes, or history of other cardiovascular or cerebrovascular disease was not reported.

We selected subjects in which comparable proportions of patients and controls demonstrated these risk factors to account for their effect on the number of white matter lesions. Analysis showed a similar increase in the number of lesions (mean 4.0 in NAION vs. 1.4 in controls). Because the data were considered nonparametric, we compared the groups by the Wilcoxon-Mann-Whitney rank-sum test in addition to the *t* test. The increased number of deep white matter lesions in NAION, significant at the $p < 0.10$ level, is further evidence that NAION occurs in the setting of diffuse small vessel disease, with CNS white matter abnormalities beyond those caused by vasculopathic risk factors such as hypertension and diabetes alone. Future studies directed at relating the number of such lesions to the incidence of subsequent contralateral NAION may indicate those patients at particular risk for its occurrence and thus most appropriately considered for potential prophylactic therapy.

The increase in number of lesions per subject was not carried through to the proportions with at least one lesion. We believe that this reflects the common occurrence of such abnormalities in all patients in this age group. Our control figures for the incidence of at least one lesion are significantly lower than the figure of 92% of Awad and associates (5) in patients aged >60 years. The difference most likely arises from patient selection; none of our patients or controls had evidence of other CNS disease, whereas those of Awad and associates (5) included patients with CNS tumors and previous irradiation, previous stroke, and hydrocephalus.

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