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Vascular Optic Neuropathy in Diabetes Mellitus

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Abstract: A retrospective analysis of clinical profiles of 20 patients with anterior and posterior ischemic optic neuropathy and diabetic papillopathy was used to evaluate optic neuropathy in diabetes. We found that vascular optic neuropathy in diabetic patients resulted from microangiopathy, macroangiopathy, and certain structural factors in the optic nerve head. **Jpn J Ophthalmol 1997;41:328–331** © 1997 Japanese Ophthalmological Society

Key Words: Diabetes mellitus, diabetic papillopathy, ischemic optic neuropathy.

Introduction

Retinopathy, nephropathy, and neuropathy are among the most common long-term complications of diabetes mellitus (DM). Neuropathy involves both somatic and autonomic nerves.[1] In the cranial nerves, ocular ischemic palsy is found relatively frequently. However, whereas the optic nerve is also susceptible to damage caused by vascular changes, the incidence of optic nerve involvement in diabetic patients has not been clearly described. Topilow and Bisland[2] and Freund et al[3] believe it is uncommon while other investigators emphasize the relationship between optic neuropathy and diabetes.[4–6] Vascular optic neuropathy in diabetics can be classified as ischemic optic neuropathy and diabetic papillopathy. In this study, we examined the pathogenesis and clinical features of these conditions.

Subjects and Methods

The study included 20 non–insulin-dependent diabetic patients, 10 men and 10 women, 46–79 years old, who were examined at the Ophthalmology Clinic of Kobe University Hospital during the past 10 years. There were 13 eyes with anterior ischemic optic neuropathy (AION), five with posterior ischemic optic neuropathy (PION), and five with diabetic papillopathy (DP). Anterior ischemic optic neuropathy, PION, and DP were diagnosed according to accepted criteria.[7,8] Optic disc sizes in AION and DP were estimated from ocular fundus photographs according to Wakakura's modification[9] of a previously described method.[10] The distance between the disc and macula, relative to the disc diameter (DM/DD), was determined by the equation:

$$[(a_1 + a_2/2) + 2b]/(a_1 + a_2)$$

where a_1 and a_2 are the horizontal and vertical diameters of the disc, and b is the distance between the disc and macula.

The DM/DD ratio ranged from 2.2 to 2.9 (average: 2.7 ± 0.2) in 30 age-matched controls.

Results

Clinical data of the 13 AION patients are shown in Table 1. There were seven men and six women, 47–72 years old (average 55.1). Visual acuity ranged from light perception to 1.5; central visual function was impaired in 10 eyes with central acuity preserved in only three. Visual field defects were altitudinal in nine eyes; only one had a nasal defect. Ophthalmoscopically, all affected eyes had swollen discs, and DP was found in two fellow eyes (cases 1 and 2). The average DM/DD ratio determined in 9 of the 13 AION eyes was 2.9; this was a statistically significant difference from the controls (Student's *t*-test; $P < 0.02$). Simple and preproliferative retinopathy was found in two eyes; six eyes had none; retinopathy regressed after photocoagulation in five eyes. Diabetic control was poor in four of these patients; one also had hypercholesteremia and two had hypertension.

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Table 1. Clinical Profiles of Anterior Ischemic Optic Neuropathy

Case	Age/Sex	Affected Eye	Visual Acuity	Visual Field	Ocular Fundus	Finding DM/DD	General
1	50/M	R	0.01	Altitudinal Defect	DR(−); (L)DP	2.9	Ophthalmic Artery Stenosis; Arteriosclerosis Obliterance
2	47/M	R	0.4	Altitudinal Defect	PPDR; (L)DP	3.0	Hypertension; HbA1C 8.0
3	72/M	L	0.03	Nasal Defect	DR(−)	n.d.	(L) Carotid Occlusion; Hypertension
4	46/F	R	1.5	Altitudinal Defect	DR(−)	2.5	
5	58/M	L	0.1	Altitudinal Defect	DR(−)	2.6	
6	63/F	R	0.7	Altitudinal Defect	DR(−)	2.7	
7	60/M	L	1.0	Altitudinal Defect	DR(−)	3.0	Hypercholesteremia
8	53/M	L	1.0	Altitudinal Defect	SDR	n.d.	
9	49/F	L	0.1	Altitudinal Defect	Reg r	2.9	HbA1c 7.9
10	48/F	R	LP		Reg r	3.2	HbA1c 8.2
11	49/M	L	HM		Reg r	n.d.	HbA1c 8.0
12	63/F	L	HM		Reg r	n.d.	
13	59/F	R	0.1	Altitudinal Defect	Reg r	2.9	

DM/DD: distance between disc and macula/disc diameter. LP: light perception. HM: hand motion. DP: diabetic papillopathy. DR: diabetic retinopathy. PPDR: preproliferative diabetic retinopathy. SDR: simple diabetic retinopathy. Reg r: regressed proliferative retinopathy. n.d.: not determined.

Two patients had an ipsilateral internal carotid or ophthalmic artery occlusion. No giant cell arteritis was noted.

Clinical data of the five PION patients are shown in Table 2. There were three men and two women, 52–79 years old. Visual acuity ranged from no light perception to 1.0; three eyes had visual field defects including central scotoma and irregular or altitudinal defects. In all, optic discs were normal on first examination with optic atrophy developing several weeks later. There was no diabetic retinopathy in this group. Internal carotid occlusion produced a soft exudate in one eye. Other possible etiologies of optic nerve disturbance were excluded by computed tomography and magnetic resonance imaging, which confirmed the absence of any orbital or intracranial masses. There was no giant cell arteritis, but three patients were hypertensive.

Clinical data of four patients (five eyes) with DP are shown in Table 3. There were two men and two women, 47–65 years old (average 52.3). In one eye, visual acuity was 0.8 (Landolt) because of a slight vitreous hemorrhage; there was one eye with cataract; all others had normal visual acuity. Visual field examinations were normal except for enlargement of the blind spot in the eye with vitreous hemorrhage. Ophthalmological examination found disc edema and telangiectasis of the epipapillary capillaries, which later resolved spontaneously, in all eyes. Vitreous opacity persisted only in the eye with vitreous hemorrhage. The optic discs in three eyes were significantly smaller than the others. Simple diabetic retinopathy or preproliferative retinopathy was each found in one eye; three eyes had no retinopathy. Three patients had uncontrolled diabetes.

Discussion

Risk factors associated with nonarteritic AION include hypertension and DM.[11–13] About 20% of dia-

Table 2. Clinical Profiles of Posterior Ischemic Optic Neuropathy

Case	Age/Sex	Affected Eye	Visual Acuity	Visual Field	Ocular Finding	General
1	62/M	L	1.0	Irregular Defect	DR(−)	Hypertension
2	52/M	R	0.03	Central Scotoma	Soft Exudate	Carotid Occlusion Hypercholesteremia
3	59/M	L	0.6	Altitudinal Defect	DR(−)	Carotid Occlusion Hypertension
4	79/F	L	LP		DR(−)	
5	73/F	L	LP		DR(−)	Hypertension

DR: diabetic retinopathy. LP: light perception.

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Table 3. Clinical Profiles of Diabetic Papillopathy

Case	Age/Sex	Affected Eye	Visual Acuity	Visual Field	Ocular Fundus	Finding DM/DD	General
1	47/F	R	1.2	Normal	DR(−)	3.1	FBG 300 mg/dL
		L	0.8	Enlargement of Blind Spot	DR(−); VH(+)	n.d.	Hypertension
2	50/M	L	1.0	Normal	DR(−); (R) AION	3.2	
3	47/M	L	1.0	Normal	PPDR; (R) AION	3.1	HbA1c 8.2
4	65/F	L	0.6	Normal	Cataract; SDR	2.8	AbA1c 8.3

DM/DD: distance between disc and macula/disc diameter. FBG: fasting blood glucose. DR: diabetic retinopathy. VH: vitreous hemorrhage. AION: anterior ischemic optic neuropathy. SDR: simple diabetic retinopathy.

betic patients develop AION, with younger patients seeming to have a higher risk.[11,13] Diabetes mellitus increases the risk of developing athero- and arteriosclerotic changes in the posterior ciliary arteries and smaller vessels, causing nonarteritic AION. There may also be a structural predisposition[14]: these patients have a smaller disc size and cup/disc ratio.[15–17] The current study corroborates the earlier reports on smaller disc size.

Diabetes mellitus also predisposes to macroangiography of the ophthalmic or carotid artery. Some studies have noted AION associated with carotid occlusion[18–20]; in the current study, confirmed causes of AION included two instances of ipsilateral macroangiopathy, with ophthalmic and carotid atheroma leading to hypocirculation and emboli. Diabetic retinopathy was found in seven cases, but there was no correlation of AION with the severity of the retinopathy. Diabetes was poorly controlled in four AION patients.

Some diabetic patients may develop a variant form of swelling of the optic nerve head.[21] Lubow and Makeley[22] described three patients with juvenile insulin-dependent DM with optic disc swelling. There are other similar descriptions of this syndrome, diabetic papillopathy (DP).[17,23–25] Although it may occur in adults,[26–28] DP patients are usually young, long-term insulin-dependent (>5 years), and may have unilateral or bilateral onset with few or no symptoms, variable association with diabetic retinopathy and a benign prognosis. The pathophysiology is still speculative.[29] Lubow and Makeley,[22] Hayreh and Zahoruk,[25] and Barner and Fledelines[30] identified the lesion as a mild subclinical form of AION. Others like Yanko et al,[31] Appen et al,[23] and Bonnet et al[32] believe that DP is the result of capillary changes, not ischemia of the superficial optic disc. Brancato et al[33] emphasized the localized damage of the peripapillary vascular radial network and supported the second hypothesis. Capillary changes in the superficial optic disc result in reversible swelling with little or no impairment of optic nerve function. These changes may distinguish DP from the ischemia of posterior ciliary artery in AION. Diabetic papillopathy, similar to AION, also occurs in patients with smaller disc sizes,[14,27,34] a finding confirmed in the current study. Typical AION also occurred in the fellow eyes of two patients with DP. Although there are differences in location and severity of optic nerve head impairment, AION and DP both seem to be related to vasculopathy and structural factors.

Posterior ischemic optic neuropathy is a rare retrobulbar ischemic change that initially causes no noticeable optic disc change; diagnosis is by exclusion of other known etiologies. Generally, PION occurs in patients with atherosclerosis and capillosclerosis, due to hypertension and DM or systemic arteritis.[35] Moor and Doro[6] reported that PION was commonly seen in diabetic patients although Miller[35] disagrees. Jabs et al[36] and Isayama and Takahashi[37] identified histopathological changes in the posterior portion of the optic nerve, including demyelination, atrophy of axons and fibrous thickening of the vessel walls, in diabetic patients.

We have previously[7,37] proposed criteria for diagnosis of nonarteritic PION. An association between PION and carotid occlusion has also been reported;[38] in this study, there were two cases of carotid artery occlusion. We suggest that ipsilateral carotid artery occlusion should be recognized as a cause of PION, as well as of AION.

Diabetes mellitus may be complicated by the development of three different types of vascular optic neuropathy: AION, PION, and DP related to arteriolosclerosis and capillosclerosis. Even if the neuropathy is not related to retinopathy, ischemic optic neuropathy is sometimes associated with atherosclerosis of ophthalmic or carotid arteries. There are also structural factors intrinsic to the optic nerve head that can lead to the development of AION and

DP. Optic nerve involvement in diabetics can result from multiple factors including microangiography, macroangiopathy, and structural predisposition.

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