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CENTRAL RETINAL VEIN OCCLUSION IN A YOUNG CHINESE POPULATION:

Risk Factors and Associated Morbidity and Mortality

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Abstract

Purpose—The purpose of this study was to assess the risk factors for central retinal vein occlusion and associated morbidity and mortality in a Chinese population.

Methods—The participants included patients with central retinal vein occlusion 40 years old and younger. Predisposing factors, mortality, and systemic complications were examined in this group.

Results—Unilateral (n = 19) and bilateral (n = 3) central retinal vein occlusions were identified in a total of 22 patients (25 eyes), with a mean follow-up time of 37 months. Hypercholesterolemia (65%), hypertriglyceridemia (64%), and hyperhomocysteinemia (42%) were all identified as risk factors. Three patients (14%) developed stroke and 1 (5%) developed transient ischemic attacks during follow-up. Renal failure and pulmonary hypertension resulted in the death of two patients. The mean initial and final visual acuities ($\pm$ standard deviation) were 20/400 ($\pm$ 20/250) and 20/500 ($\pm$ 20/320), respectively, and treatments did not result in vision improvement ($P = 0.57$). The poor visual prognosis was likely due to macular edema in 7 eyes (28%), optic atrophy in 4 eyes (16%), and secondary glaucoma in 3 eyes (12%).

Conclusion—Morbidity and mortality are high in young Chinese patients with central retinal vein occlusion who may have associated serious complications including stroke, blindness, and death. Central retinal vein occlusion may serve as an initial clinical presentation of serious systemic diseases.

Keywords

central retinal vein occlusion; Chinese; morbidity; mortality; risk factors

Central retinal vein occlusion (CRVO) is a retinal vascular disorder that is prevalent in old age and relatively uncommon in younger patients. The etiology and risk factors of CRVO are poorly understood in younger patients. Retinal vein inflammation has been proposed as a pathogenesis,^{1,2} whereas other studies have suggested a multifactorial etiology unique to

younger patients.³ The percentage of CRVO cases with systemic disease is greater in older (74%) than in younger patients (40–67%).^{2–4} Associated medical conditions in younger patients include hypertension, ^{2,3} hyperlipidemia,^{3,5} carotid artery disease,^{3,6} and hypercoagulability.^{3,7–13}

The majority of CRVO studies in younger patients have been conducted on Caucasians.^{2–5, 7,9–26} Previous CRVO studies in patients of Chinese descent have not targeted younger patients.^{27–30} Hence, clinical features, predisposing factors, visual outcomes, and mortality are not well established for the latter group. The aim of this study is to investigate predisposing risk factors and associated morbidity and mortality in young Chinese CRVO patients.

Methods

We conducted a retrospective case review of CRVO patients 40 years old or younger treated in Chang Gung Memorial Hospital in Taiwan between January 2000 and December 2007. Patient data were collected after approval by the hospital's institutional review board. By using the ICD9 diagnosis code 36235 (CRVO) and using the criterion of 40 years old and younger, a total of 103 patient records were retrieved from our hospital's database. After excluding patients with follow-up <6 months and with hemi-CRVO or other retinal vessel occlusion diseases, a total of 22 patient records were collected for this study.

Patient data collected included age, sex, associated medical history, previous ocular history, body mass index (BMI), visual acuity, intraocular pressure, anterior and posterior segment abnormalities, fluorescein angiography, ocular coherence tomography (in cases of macular edema), laboratory findings, other clinical tests, treatment, and morbidity and mortality. A detailed case workup with clinical consultations from the cardiology, neurology, endocrinology, and rheumatology services was recommended if CRVO was the sole complaint at initial presentation with no other medical history.

The age at initial CRVO diagnosis was designated as current age, and ischemic CRVO was classified according to clinical signs, such as the presence of relative afferent pupillary defect, marked visual impairment <20/200, reduced b-wave amplitude on electroretinography, ophthalmoscopy findings, and capillary nonperfusion on fluorescein angiography.^{3,31,32} Follow-up periods were measured from the time of initial CRVO diagnosis. Hypertension was defined by a blood pressure value >140/90 mmHg or by the concurrent use of antihypertensive medications. Hypercholesterolemia was defined by cholesterol levels >200 mg/dL and hypertriglyceridemia by total triglyceride levels >150 mg/dL. Homocysteine levels >12 μmol/L defined hyperhomocysteinemia, and BMI measurements were calculated by the patient's initial body weight in kilograms divided by the square of the patient's height in meters (kg/m²). Patients were classified as underweight (BMI <18.5 kg/m²), normal weight (BMI of 18.5–24.9 kg/m²), overweight (BMI of 25–29.9 kg/m²), or obese (BMI >30 kg/m²), following World Health Organization criteria.³³

Data analysis was conducted with the SPSS (Version 13.0; SPSS Inc., Chicago, IL) and SAS (Version 9.1; SAS Institute, Inc., Cary, NC) software programs. All of the patients' conditions were described by descriptive analysis. Two-sample *t*-test was performed to examine the difference between the ischemic and nonischemic groups. Statistical significance was defined as *P* < 0.05.

Results

There were 22 patients (25 eyes), with 12 women and 10 men included in this study. The mean age (±SD) was 28.5 (±7.54) years (range, 11–40 years), and the mean follow-up time was 37

months. All patients had at least 6 months of follow-up except for 1 patient who died secondary to pulmonary hypertension 3 months after the initial CRVO diagnosis.

Central retinal vein occlusion occurred in the right eye in 13 patients (59%), in the left eye in 6 patients (27%), and in both eyes in 3 patients (14%). Ischemic ($n = 9$ eyes) and nonischemic ($n = 16$ eyes) CRVOs were identified in this study. Systemic and ocular findings are described in Tables 1 and 2, respectively.

Initial visual acuity measurements ranged from 20/20 to no light perception. The visual acuity measured was $\geq 20/40$ in 32% ($n = 8$) of the eyes, between 20/50 and 20/100 in 8% ($n = 2$) of the eyes, and $< 20/100$ in 60% ($n = 15$) of the eyes. The mean initial visual acuities ($\pm$ standard deviation [SD]) were 20/400 ($\pm 20/250$) and the mean final visual acuity was 20/500 ($\pm 20/320$). The difference was not statistically significant ($P = 0.57$). Four eyes (16%) had a final outcome of no light perception. Complications included persistent macular edema ($n = 7$), optic atrophy ($n = 4$), triamcinolone acetamide (TA)-induced glaucoma ($n = 3$), and neovascular glaucoma ($n = 2$). All these complications resulted in visual acuity of 20/100 or worse. The mean logMAR final visual acuity ($\pm$ SD) for ischemic type CRVO (2.59 ± 0.66) was significantly worse than that for non-ischemic type CRVO (0.79 ± 1.00 ; $P \leq 0.0001$).

Only 6 of 22 patients (27%) were initially identified with systemic risk factors. The risk factors included hypertension, found in 6 patients (100%); systemic lupus erythematosus (SLE), in 2 patients (33%); renal failure on dialysis, in 2 patients (33%); heart disease, in 2 patients (33%); diabetes, in 1 patient (17%); and obesity using diet pills, in 1 patient (17%). All six patients were using systemic medications before the development of CRVO. Although a majority of the patients initially presented with no systemic risk factors, a thorough evaluation resulted in the identification of at least 1 risk factor (Table 3) in 20 of the 22 patients (91%). The most prevalent risk factors were hypercholesterolemia in 11 of 17 patients (65%), hypertriglyceridemia in 9 of 14 patients (64%), hyperhomocysteinemia in 5 of 12 patients (42%), overweight or obesity in 8 of 22 patients (36%), hypertension in 8 of 22 patients (36%), and SLE in 3 of 22 patients (14%). The percentages shown here represent the proportion of patients tested and not the entire cohort.

Three patients were diagnosed with stroke, and one patient had a transient ischemic attack during follow-up. One of the stroke patients was later diagnosed with mitochondrial myopathy, encephalopathy, lactic acidosis, and stroke (MELAS), with CRVO ocular manifestations as the initial presentation of underlying disease. Death occurred in 2 patients as a result of renal failure (death at 30 months after initial CRVO diagnosis) and pulmonary hypertension (death at 3 months after initial CRVO diagnosis). All patients who were diagnosed with a systemic condition after the presentation of CRVO also received treatment for these conditions.

Bilateral CRVO was present in 3 patients (14%), and all 3 had hypertension and hypercholesterolemia. Two were obese, 2 were smokers, 2 had migraines, 2 had hypertriglyceridemia, and 1 had hyperhomocysteinemia (Table 4). In the 3 patients with bilateral CRVO, there was a single incidence of stroke (33%), a single incidence of transient ischemic attack (33%), and an acute occurrence of SLE (33%), which suggest a high morbidity risk in these patients.

Medical and surgical treatments were performed in 64% of the eyes ($n = 16$); there was no treatment in 36% ($n = 9$). Treatments included oral folic acid and vitamin B₆ ingestion in 2 patients (12%); oral folic acid and vitamin B₆ ingestion with intravitreal TA in 1 eye (4%); oral folic acid and vitamin B₆ ingestion with radial optic neurotomy and TA in 1 eye (4%); focal and/or panretinal photocoagulation in 5 eyes (20%); intravitreal TA injection in 2 eyes (8%); intravitreal bevacizumab injection in 1 eye (4%); vitrectomy and radial optic neurotomy in 1 eye (4%); vitrectomy and panretinal photocoagulation in 1 eye (4%); and vitrectomy with

radial optic neurotomy and TA in 1 eye (4%; Table 2). There were no visual improvements despite various treatments ($P = 0.57$).

Discussion

This study showed that morbidity and mortality are high in young Chinese patients with CRVO, particularly in bilateral CRVO cases. These patients may display serious associated diseases or complications such as stroke, blindness, or death. The majority of patients in our study had no previously identified systemic diseases or risk factors. However, associated risk factors and systemic diseases were found in 91% of the patients after thorough evaluations, suggesting that the occurrence of CRVO in young patients may be an early marker of life-threatening systemic diseases. All patients were young with potentially treatable and controllable systemic diseases. Therefore, we recommend thorough systemic evaluation to identify risk factors and appropriate treatment in such patients.

Six of the 22 patients (27%) initially presented with systemic risk factors and were taking medication before the development of CRVO. Medications such as diuretics,^{3,34} sympathomimetics,^{3,35,36} oral contraceptives,^{3,5,37} and antipsychotics³⁸ have been linked to the development of the disease. These may result in hemoconcentration, thrombophilia, or dehydration,^{3,15} which precipitate its development. Antihypertensive medications taken by the patients, including β -blockers and calcium channel blockers, have not been reported to cause conditions that precipitate CRVO. However, when taken in combination with diuretics, angiotensin II receptor antagonists increase dehydration.^{39,40} Medications for SLE have not been linked to the development of CRVO; however, patients with SLE are already prone to hemoconcentration and thrombophilia because of circulating antibodies. Two patients undergoing dialysis were also taking diuretics, which increases the likelihood of dehydration. Medications for heart disease and diabetes have not been reported to cause CRVO. Diet pills such as laxatives do increase dehydration in the patient. Therefore, it is likely that some of the medications may cause or increase the likelihood of the development of CRVO. However, it is difficult to establish a direct causal relationship between systemic medication use and CRVO.

The prevalence of systemic disease ranges from 40% to 67% in young Caucasian CRVO patients,^{3,4} 18% to 28% in those with ischemic-type CRVO,²⁻⁴ and 1% to 14% in those with bilateral CRVO.³ Most eyes in these studies had visual acuity of better than 20/40.³ The incidence of systemic disease association (77%), ischemic-type CRVO (36%), and bilateral CRVO (14%) was higher in our Chinese population than in the Caucasian population reported in previous studies. A final visual acuity of 20/100 or better was noted in only 10 eyes (40%). Central retinal vein occlusion in young Caucasian patients has been associated with hypertension, diabetes, hyperlipidemia, hypercoagulability, mitral valve prolapse, collagen vascular disease, carotid artery disease, migraines, and smoking.^{3,7,41} Associated systemic diseases were not identical in the Chinese versus Caucasian populations. Central retinal vein occlusion in young Chinese patients was most frequently associated with hypercholesterolemia (65%), hypertriglyceridemia (64%), and hyperhomocysteinemia (42%). Homocysteine was elevated in 42% of the patients and was higher than that previously reported in Caucasians (9.5–16.1%).^{7,12,24} Several factors might account for the differences between Chinese and Caucasian patients. First, in a study of vascular disease assessment in different ethnicities, Chinese individuals exhibited a higher incidence of stroke than Caucasian patients, because of differences in visceral adiposity, insulin resistance, and novel risk markers such as C-reactive protein, adiponectin, and plasma homocysteine.⁴² This suggests a higher correlation between CRVO and stroke in young Chinese patients than in young Caucasian patients, a possibility of which clinicians should be aware. Second, the follow-up periods were different in the studies, and longer follow-up times may show additional morbidities. Third, patient compliance with treatment may vary in different regions. Finally, the patients' ages differed between the studies.

The definition of CRVO in young patients varies widely in previous studies (age range, 40–56 years), and there is no consensus as to appropriate age range to define young adults. We chose 40 years of age, the lowest cut-off used in previous studies of CRVO in young adults.

Of note, steroid treatment may pose specific complications, such as secondary glaucoma, particularly in young adults. Five patients in our study received intravitreal TA injections, either alone or in combination with other procedures, and three of these developed secondary glaucoma. Other studies have shown that younger ages might serve as risk factors for increased intraocular pressure and intractable glaucoma after intravitreal TA injections⁴³ or TA injections in the posterior subtenon.²⁹ Steroid administration for macular edema in young patients with CRVO could also result in secondary glaucoma and contribute to poor visual outcomes. Intravitreal bevacizumab injections may serve as alternative means of treatment for macular edema secondary to retinal vein occlusion, with good outcome and less adverse effects.⁴⁴

Study limitations included the retrospective nature of the study, small sample sizes, lack of a control group, and variable lengths of follow-up. Also, because of the wide spectrum of visual acuity at presentation and the heterogeneity of treatments, the statistical analysis of the visual outcome is not a meaningful comparison. In addition, because the classification of ischemic and nonischemic CRVO was based on one of the ancillary tests, this classification was not standardized among the patients. Furthermore, a number of laboratory findings were unavailable because of poor patient compliance, whereas referral bias may also contribute to the increased incidence of ischemic CRVO. Nevertheless, this is, to date, the largest case series of CRVO in a young Chinese population, and some useful clinical information can be gleaned from this study.

This is the first case series investigating CRVO in young Chinese patients. We found a high percentage of associated risk factors, poor visual prognosis, high mortality, and severe complications in this group compared with previous studies in white populations. Visual prognosis was poor in most patients despite treatment, and a high percentage of young Chinese patients with CRVO may develop stroke and transient ischemic attack, especially in bilateral cases. We suggest extensive investigation for systemic diseases in CRVO cases, because treatment and follow-up can prevent serious complications such as cerebrovascular events and mortality.

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Table 1

Systemic Findings for 22 Young CRVO Patients

Patient	Age (Years)	Sex	Homocysteine	TG	Chol	Protein C and S, aPTT, PT, Antithrombin III	Lupus Anticoagulant/ Anticardiolipin/C3&4/ ANA	Follow-Up (Months)	Systemic Disease and Complication
1	11	F	Normal	Normal	Normal	Abnormal	No/—/—/No	27	Stroke and MELAS
2	19	F	—	—	—	—	—/—/—/—	97	—
3	19	M	Normal	—	Normal	Normal	No/—/—/No	9	—
4	19	F	Normal	Normal	Normal	Normal	No/Yes/No/Yes	42	—
5	20	F	Normal	Normal	Elevated	Normal	No/No/No/No	6	—
6	23	F	—	—	—	—	No/No/No/No	86	HTN and SLE
7	26	M	Elevated	—	—	—	—/—/—/—	18	—
8	26	M	Normal	Elevated	Elevated	Normal	No/Yes/—/Yes	62	HTN and stroke
9	26	M	Normal	Normal	Normal	—	—/—/—/—	26	—
10	29	M	Elevated	Normal	Normal	Abnormal	No/No/No/No	35	HTN and stroke
11	29	F	—	Elevated	Elevated	—	—/—/—/No	41	HTN and DM
12	30	F	—	Elevated	Elevated	—	—/—/—/—	33	SLE
13	33	M	Elevated	—	Elevated	—	—/—/—/—	36	—
14	33	F	—	Elevated	Elevated	Abnormal	Yes/—/No/Yes	3	HTN, SLE, and mortality
15	33	F	—	Elevated	Normal	Normal	—/—/—/—	12	HTN
16	33	F	Normal	—	—	Normal	—/—/—/—	35	—
17	34	F	—	Elevated	Elevated	—	—/—/No/No	29	HTN, renal failure, and mortality
18	34	M	Elevated	Elevated	Elevated	—	—/—/—/—	29	HTN and TIA
19	36	M	Elevated	Elevated	Elevated	Normal	No/—/—/—	9	—
20	37	M	—	—	—	—	—/—/—/—	80	—
21	38	F	—	Elevated	Elevated	—	—/—/—/—	52	—
22	40	M	—	—	—	—	—/—/—/—	49	—

ANA, antinuclear antibody; aPTT, activated partial thromboplastin time; Chol, cholesterol; DM, diabetes mellitus; F, female; HTN, hypertension; M, male; MELAS, mitochondrial myopathy, encephalopathy, lactic acidosis, and stroke; No, negative finding; PT, prothrombin time; TIA, transient ischemic attack; TG, triglyceride; Yes, positive finding; —, unavailable.

Table 2

Ocular Findings for 22 Young CRVO Patients

Patient	Eye(s)	Initial Visual Acuity	Final Visual Acuity	Type	Ocular Treatment	Ocular Complications
1	OD	CF	20/200	Nonischemic	Observation	Optic atrophy
2	OS	20/30	20/20	Nonischemic	FRP	—
3	OS	CF	CF	Ischemic	Observation	Optic atrophy
4	OS	20/200	20/50	Nonischemic	FRP/PRP	—
5	OD	20/25	20/30	Nonischemic	Observation	—
6	OD	20/40	HM	Nonischemic	Observation	—
7	OS	20/200	CF	Nonischemic	Observation	Macular edema and 2° glaucoma
8	OD	NLP	NLP	Ischemic	TA	Optic atrophy
9	OD	20/50	20/20	Ischemic	Observation	Optic atrophy
10	OD	20/20	20/20	Nonischemic	Observation	—
11	OD	HM	NLP	Nonischemic	Folic acid/vitamin B ₆	—
12	OS	CF	CF	Ischemic	FRP/PRP	—
13	OD	20/400	CF	Nonischemic	TA	Macular edema
14	OD	20/50	20/30	Nonischemic	Folic acid + vitamin B ₆ + RON + TA	Macular edema and 2° glaucoma
15	OD	20/30	20/20	Nonischemic	Observation	—
16	OD	20/20	20/50	Nonischemic	Bevacizumab	—
17	OD	20/400	NLP	Nonischemic	PRP	—
18	OD	20/20	20/20	Ischemic	FRP/PRP	—
19	OS	20/20	20/20	Nonischemic	Folic acid/vitamin B ₆	—
20	OD	CF	20/400	Ischemic	Observation	—
21	OD	CF	CF	Ischemic	Folic acid + vitamin B ₆ + TA	Macular edema and 2° glaucoma
22	OS	CF	20/200	Ischemic	VT + PRP	Macular edema
				Ischemic	VT + RON + TA	Macular edema
				Nonischemic	VT + RON	Macular edema

2°, secondary; CF, counting fingers; FRP, focal retinal photocoagulation; HM, hand motion; NLP, no light perception; PRP, panretinal photocoagulation; RON, radial optic neurotomy; VT, vitrectomy.

Table 3**Risk Factors Associated With Young CRVO**

Risk Factors	Incidence, n (%)
Hypercholesterolemia	11/17 (65)
Hypertriglyceridemia	9/14 (64)
Hyperhomocysteinemia	5/12 (42)
Overweight or obesity (BMI >25 kg/m ²)	8/22 (36)
Hypertension	8/22 (36)
Smoking	7/22 (32)
Migraine	7/22 (32)
Systemic lupus erythematosus	3/22 (14)
Diabetes mellitus	1/22 (5)

Table 4

Risk Factors and Systemic Diseases in Patients With Bilateral CRVO

Risk Factors	Patient 6	Patient 8	Patient 18
Hypertension	+	+	+
Hypercholesterolemia	+	+	+
Obesity	+	–	+
Smoking	–	+	+
Migraine	+	+	–
Hypertriglyceridemia	–	+	+
Hyperhomocysteinemia	–	–	+
Systemic disease	SLE	Stroke	TIA

TIA, transient ischemic attack; +, positive finding; –, negative finding.