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Influence of diabetes and diabetes type on anatomic and visual outcomes following central rein vein occlusion

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Learning objectives

Upon completion of this activity, participants will be able to:

1. Compare the prevalence of central retinal vein occlusion (CRVO) in diabetic patients and nondiabetic patients
2. Describe outcomes after CRVO in diabetic patients and nondiabetic patients
3. Describe outcomes after CRVO in patients with type 1 diabetes and those with type 2 diabetes

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CLINICAL STUDY

Influence of diabetes and diabetes type on anatomic and visual outcomes following central rein vein occlusion

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Abstract

Purpose **To determine the influence of diabetes and diabetes type on ocular outcomes following central retinal vein occlusion (CRVO).**

Methods **Retrospective chart review of all patients evaluated over a 4-year period in a tertiary diabetes eye care center. Ophthalmic findings were recorded including visual acuity and the presence of retinal neovascularization at presentation, after 3–6 months, and at last follow-up.**

Results **The records of 19 648 patients (13 571 diabetic; 6077 nondiabetic) were reviewed. The prevalence of CRVO in diabetic patients ($N=72$) and nondiabetic patients ($N=27$) were 0.5 and 0.4%, respectively. Disc neovascularization (21.3 *vs* 0.0%, $P=0.05$) and panretinal photocoagulation (PRP) (48.7 *vs* 21.4%, $P=0.01$) were more common in diabetic patients compared with nondiabetic patients. Compared with type 2 diabetic patients, retinal neovascularization (28.6 *vs* 3.7%, $P=0.004$) and subsequent PRP (78.6 *vs* 41.9%, $P=0.01$) were more likely in type 1 patients. Optic nerve head collateral vessels (CVs) were observed less than half as often (21.4 *vs* 56.5%, $P=0.04$) in patients with type 1 diabetes. Presence of optic nerve head CVs at baseline was associated with less likelihood of PRP (14.3 *vs* 46.1%, $P=0.03$).**

Conclusions **In this cohort, the rates of CRVO in diabetic and nondiabetic patients were similar to previously published population-based studies. Following CRVO, diabetic patients had higher rates of disc neovascularization and were more likely to require subsequent PRP than nondiabetic patients. As compared with CRVO patients with type 2 diabetes, patients with type 1 diabetes and CRVO had worse anatomic outcomes with substantially increased risks of retinal neovascularization and PRP; however, final visual acuity outcomes were similar.**

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Keywords: central retinal vein occlusion; diabetes mellitus; retinal neovascularization; retinal ischemia; panretinal laser photocoagulation

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Introduction

Central retinal vein occlusion (CRVO) is a retinal vascular disease that frequently results in significant visual loss.[1–3] Population-based studies estimate that the prevalence ranges from 0.1%[4] to 0.8%[5] and that the 15-year cumulative incidence is 0.5%.[6] CRVO is observed in all age groups, with increasing incidence with advancing age.[6,7] CRVO is classified into two distinct groups with different visual outcomes: nonischemic and ischemic.[8] The ischemic CRVO generally presents with poorer visual acuity at baseline, worse visual prognosis and higher risk of developing neovascularization as compared with the nonischemic group.[8,9] Visual decline in patients with CRVO may occur from ischemic injury to the retina, macular edema, vitreous hemorrhage, retinal neovascularization, and/or

neovascular glaucoma.[10] There is an associated vision-related decline in quality of life.[11]

Multiple systemic and ocular conditions are associated with CRVO.[7,12–21] Many studies have confirmed higher prevalence of diabetes mellitus (DM) in patients with CRVO.[16,21–24] Co-existing DM is reported in 10–34% of patients with CRVO and may affect the natural history in this subgroup of patients.[25,26] Patients with DM have a higher risk of subsequently developing ischemic CRVO and neovascular complications.[14,27] A higher prevalence of DM has been noted among those patients developing CRVO. However, detailed assessment of risk factors in DM patients that may predict the development of retinal ischemia and neovascularization following CRVO is lacking. The influence of DM type on the natural course of CRVO is also unknown. In the current study, we compared nondiabetic and diabetic patients with CRVO and evaluated the effect of diabetes type and systemic and ocular risk factors on ophthalmic outcomes in an academic tertiary care diabetes center.

Materials and methods

A structured, retrospective medical record review of all patients seen at the Beetham Eye Institute of the Joslin Diabetes Center from 1 January 2004 to 15 November 2008 was performed. The study was approved by the Joslin Diabetes Center Institutional Review Board prior to the review of the patients' records. A structured electronic search query from the electronic medical record was used to identify all CRVO patients with ICD-9 coded diagnosis of 362.35 (CRVO). The individual medical records of all identified patients were retrieved and all pertinent information was recorded on a standardized form. The diagnoses of CRVO and DM were confirmed based on the systemic and clinical characteristics documented at the initial visit. Diabetes type was determined based on the physician coded ICD-9 diagnosis in the patient's electronic medical records.

Baseline demographic factors including age, gender, ethnicity, and pertinent systemic medical risk factors associated with progression of diabetic retinopathy (DR) or increased risk of CRVO were noted at the initial visit. The systemic medical and ophthalmic risk factors evaluated included those published in previous studies: hypertension, DM, hyperlipidemia, cardiovascular disease, smoking history, open-angle glaucoma, and elevated intraocular pressure (IOP).[7,12–21] The ophthalmic findings from all patients at the initial (visit I), 4-month (visit M; window = 3–6 months), and final follow-up (visit F) were recorded. Data from the visit prior to development of CRVO were also recorded when available (visit P). If a patient was diagnosed with bilateral CRVO, ophthalmic findings were recorded individually for each eye at each of the three specified visits.

Recorded visual and anatomic outcomes included best-corrected Early Treatment Diabetic Retinopathy Study (ETDRS) protocol visual acuity; IOP measured by Goldman applanation tonometry; presence of neovascularization of the iris and/or angle, optic disc, or elsewhere on the retina; presence of neovascular glaucoma; clinical DR severity; presence of macular edema; and presence of optic nerve head collateral vessels (CVs). All refractionists, visual acuity examiners, and visual examination rooms were clinical trial certified. Standardized templates were used to record the presence of neovascularization, CV, DR severity, and macular edema. Consistency of ophthalmologists' grading of DR at the Beetham Eye Institute has been established as comparable to the inter-reader results of the ETDRS study and masked evaluation of ETDRS standardized photographs.[28] Fundus photography and fluorescein angiography were reviewed when the images were available. Retinal ischemia was established based on capillary nonperfusion observed on fluorescein angiography. The dates of all ophthalmic procedures after onset of CRVO were recorded, including those for cataract surgery, glaucoma surgery, intravitreal injection, panretinal laser photocoagulation, vitrectomy, and radial optic neurotomy.

We certify that all applicable institutional and governmental regulations were followed during this research.

Statistical analysis

All analyses were performed using Statistical Analyses System software V9.2 (SAS Institute, Cary, NC, USA). For patients with fewer than three visits, the 'last observation carried forward' method was used. If the last visit (visit F) was within 3–6 months of baseline, data from this visit were also used for analyses pertaining to the visit M 3–6-month follow-up. Nonparametric analyses (Wilcoxon rank sums) were used to compare distributions of continuous variables between groups. The χ^2-test was used to compare frequencies of categorical variables. For these exploratory analyses, $P < 0.05$ was defined as statistically significant.

Results

A total of 104 eyes of 99 patients with CRVO were identified from the 5-year cohort of 19 648 patients. The overall prevalence was 0.5%. The right eye only was affected in 46 patients (44.2%) and 5 patients (5.1%) had bilateral CRVO. Of the 13 571 DM patients, 76 eyes of

72 patients developed CRVO (0.5%). Among the 6077 nondiabetic patients, 28 eyes of 27 patients developed CRVO (0.4%). Individual eye involvement and bilateral CRVO prevalence did not differ significantly between DM and nondiabetic patients. The mean age for the entire CRVO cohort was 65.3 ± 14.2 (range: 30.1–95.1) years. CRVO patients with DM tended to be younger compared with CRVO patients without DM but this difference was not statistically significant (63.9 *vs* 69.0 years, $P = 0.22$). The epidemiological characteristics of the study population are presented in Table 1.

Table 1 Baseline characteristics in diabetic *vs* nondiabetic patients with CRVO

	CRVO with DM	*CRVO without DM*	P-*value*
Total patients	72	27	
Total eyes	76	28	
Total bilateral CRVO	4 (5.6%)	1 (3.7%)	
Eyes with angiograms	36 (47.4%)	18 (64.3%)	0.35
Ischemic CRVO	5 (13.9%)	1 (5.6%)	0.65
Mean age (years)	63.9	69.0	0.22
Gender			0.43
Male (%)	43.1 ($n = 31$)	51.9 ($n = 14$)	
Female (%)	56.9 ($n = 41$)	48.1 ($n = 13$)	
Ethnicity			0.17
Caucasian (%)	78.7 ($n = 48$)	82.3 ($n = 14$)	
African-American (%)	14.7 ($n = 9$)	5.9 ($n = 1$)	
Hispanic (%)	6.6 ($n = 4$)	5.9 ($n = 1$)	
Asian (%)	0.0 ($n = 0$)	5.9 ($n = 1$)	

Abbreviations: CRVO, central retinal vein occlusion; DM, diabetes mellitus.

Comorbidities in diabetic vs nondiabetic CRVO patients

Among CRVO patients, the prevalence of systemic hypertension, hyperlipidemia, and cardiovascular disease was 78.8, 56.6 and 34.3%, respectively. Less prevalent was the presence of anemia (9.1%) and renal disease (7.1%). The prevalence of systemic hypertension (84.7 *vs* 63.0%, $P = 0.02$), use of antihypertensive medications (80.6 *vs* 51.9%, $P < 0.01$), cardiovascular disease (40.3 *vs* 18.5%, $P = 0.04$), hyperlipidemia (66.7 *vs* 29.6%, $P < 0.001$), and hyperlipidemia treatment (61.1 *vs* 25.9%, $P = 0.003$) were significantly higher in DM patients than in nondiabetic patients (Table 2). In contrast, systolic and diastolic blood pressures (BPs) were not significantly different in DM patients (mean BP: 136/75 mmHg) compared with nondiabetic patients (mean BP: 131/75 mmHg). DM patients had a higher prevalence of renal disease (9.7 *vs* 0.0%, $P = 0.93$), anemia (9.7 *vs* 7.4%, $P = 0.72$), smoking history (23.6 *vs* 22.2%, $P = 0.80$), and use of anticoagulation medications (41.7 *vs* 37.0%, $P = 0.78$) such as aspirin, clopidogrel, and/or warfarin as compared with nondiabetic patients; however, these differences were not statistically significant.

DR was present at baseline exam in 66.7% of CRVO eyes of DM patients. Among these eyes with DR, 64.6% had mild nonproliferative DR (NPDR), 12.5% had moderate–severe NPDR, and 22.9% had proliferative DR (PDR). At the first visit following CRVO (3–6 months), there was an increase in the percentage of patients with PDR (from 15.3 to 23.9%) as well as moderate NPDR (from 4.2 to 7.5%) and a decrease in the percentage of patients with mild NPDR (from 43.1 to 28.4%).

Table 2 Prevalence of systemic risk factors at baseline visit in patients with CRVO

	CRVO with DM	*CRVO without DM*	P-*value*
Systolic blood pressure, mean (±SD) (mmHg)	137 (±19)	131 (±14)	0.46
Diastolic blood pressure, mean (±SD) (mmHg)	75 (±12)	78 (±14)	0.37
Presence of hypertension (%)	84.7	63.0	0.02
Use of antihypertensive drugs (%)	80.6	51.9	0.008
Hyperlipidemia (%)	66.7	29.6	<0.001
Use of lipid lowering drugs (%)	61.1	25.9	0.003
CVD (%)	40.3	18.5	0.04
Use of anticoagulation drugs (%)	41.7	37.0	0.78
Aspirin (%)	31.9	25.9	0.63
Warfarin (%)	8.3	7.4	0.92
Clopidogrel (%)	8.3	3.7	0.45
Renal disease (%)	9.7	0.0	0.93
Anemia (%)	9.7	7.4	0.72
Smoking			0.95
Never (%)	72.2	77.8	
Former (%)	16.7	14.8	
Present (%)	6.9	7.4	

Abbreviations: CRVO, central retinal vein occlusion; CVD, cardiovascular disease; DM, diabetes mellitus.

Table 3 Comparison of frequency of ophthalmic procedures in CRVO patients with and without diabetes and patients with type 1 and type 2 DM

Procedures	*CRVO with DM (N = 76)*	*CRVO without DM (N = 28)*	P-*value*	*CRVO with type 1 DM (N = 14)*	*CRVO with type 2 DM (N = 62)*	P-*value*
PRP	48.68% (37)	21.43% (6)	0.01	78.57% (11)	41.94% (26)	0.01
Intravitreal injection	9.21% (7)	10.71% (3)	0.82	7.14% (1)	9.68% (6)	0.77
Pars plana vitrectomy	13.16% (10)	7.14% (2)	0.39	14.29% (2)	12.90% (8)	0.89
Cataract surgery	15.79% (12)	10.71% (3)	0.20	14.29% (2)	17.74% (11)	0.76
Glaucoma surgery	3.95% (3)	0.00% (0)	0.29	0.00% (0)	4.84% (3)	0.40
Radial optic neurotomy	0.00% (0)	3.57% (1)	0.10	0.00% (0)	0.00% (0)	

Abbreviations: CRVO, central retinal vein occlusion; DM, diabetes mellitus; N, Number of eyes with CRVO; PRP, panretinal photocoagulation.

CRVO outcomes in diabetic vs nondiabetic patients

In the subgroup of eyes with visits prior to the onset of the CRVO ($N = 88$), the mean logMAR visual acuity was 0.17 (Snellen equivalent 20/30) prior to developing CRVO. Mean visual acuity at the initial visit after CRVO declined to 0.79 (Snellen equivalent 20/123) and the mean logMAR at last follow-up was 1.16 (Snellen equivalent 20/290). Patients with DM tended to have slightly worse logMAR visual acuity at the initial visit after CRVO (0.8316 *vs* 0.6653; $P = 0.89$) and final visit (1.1771 *vs* 1.1206; $P = 0.95$); however, these differences were not statistically significant.

Ophthalmic procedure frequencies are shown in Table 3. Panretinal photocoagulation (PRP) after CRVO was more than twice as common in eyes of patients with DM (48.7%) than in eyes of patients without DM (21.4%, $P = 0.01$). The presence of optic nerve head CVs at initial visit was associated with more than threefold lower rates of PRP (14.3 *vs* 46.1%, $P = 0.03$). Cataract extraction rates were similar in CRVO eyes with DM compared with CRVO eyes without DM (15.8 *vs* 10.7%, $P = 0.20$). Similarly, there were no statistical differences noted for intravitreal injection, pars plana vitrectomy, glaucoma surgery, or radial optic neurotomy.

Ischemic vs nonischemic CRVO outcomes in diabetic and nondiabetic patients

Fluorescein angiography was available and reviewed according to Standard of Care *vs* Corticosteroid for Retinal Vein Occlusion (SCORE) study criteria in 54 eyes (52%). Baseline parameters of eyes with angiograms did not differ significantly from eyes where angiograms were not available. As shown in Table 1, 6 (11%) of the 54 evaluated eyes had ischemic CRVO by fluorescein angiography, and 5 (83.3%) of these eyes were from diabetic patients (1 eye type 1 DM, 4 eyes type 2 DM). In this partial cohort, trends were evident, but none reached statistical significance. Ischemic CRVO tended to be more common in eyes of subjects with DM than in those without DM (13.9 *vs* 5.6%, $P = 0.36$). Ischemic CRVO tended to be slightly more common in eyes with type 2 DM than in eyes with type 1 DM (15.4 *vs* 10%, $P = 0.68$). However, owing to the small number of ischemic CRVO in this cohort overall, comparisons of risks for ischemic *vs* nonischemic CRVO could not be analyzed.

CRVO and glaucoma

Primary open-angle glaucoma and use of glaucoma medications were more common in nondiabetic patients. Nondiabetic subjects with CRVO were over four times more likely to be using glaucoma medications prior to CRVO diagnosis (62.5 *vs* 13.2%, $P = 0.002$) and had a lower mean IOP (14.0 *vs* 16.1 mmHg, $P = 0.02$) than diabetic subjects who developed CRVO. All eyes with diabetes and ischemic CRVO were on glaucoma medications on follow-up (100 *vs* 26,9%, $P = 0.03$) and on the final visit (100 *vs* 46.4%, $P = 0.05$).

CRVO outcomes by diabetes type

Among diabetes patients with CRVO, 19.4% ($n = 14$) had type 1 DM and 80.6% ($n = 58$) had type 2 DM. The mean duration of DM was 16.0 ± 10.4 (1.5–45.0) years, with a shorter duration observed among type 1 DM patients (12.1 ± 6.7 years) than for type 2 DM patients (27.1 ± 10.0 years, $P < 0.0001$). The mean HbA1c in DM patients was 7.7 ± 1.3% (5.0–11.3). The mean HbA1c was higher in type 1 DM (8.4 ± 1.2%) than in type 2 DM (7.6 ± 1.2%, $P = 0.02$) (Table 4).

Neovascularization of all types tended to be more common in DM patients with CRVO than in nondiabetic patients with CRVO. This finding was particularly true for neovascularization of the disc (NVD) after CRVO, which was much more likely in eyes of DM patients as compared with nondiabetic patients (21.3 *vs* 0.0%, $P = 0.05$, Table 5). Compared with type 2 DM, retinal

Table 4 Baseline characteristics in type 1 *vs* type 2 diabetes patients with CRVO

	Type 1 DM	*Type 2 DM*	P-*value*
Total Patients (%)	19.4 ($n=14$)	80.6 ($n=58$)	
Duration of DM, mean ± SD (years)	27.1 ± 10.0	12.1 ± 6.7	<0.0001
HbA1c value, mean ± SD (%)	8.4 ± 1.2	7.6 ± 1.2	0.02
Main treatment			
Lifestyle/diet (%)		6.9 ($n=4$)	
Oral hypoglycemic (%)		62.1 ($n=36$)	
Insulin (%)	100 ($n=14$)	31.0 ($n=18$)	

Abbreviations: CRVO, central retinal vein occlusion; DM, diabetes mellitus; HbA1c, hemoglobin A1c.

neovascularization from CRVO was eight times more likely (28.6 *vs* 3.7%, $P=0.004$) and optic nerve head CVs were observed less than half as often (21.4 *vs* 56.5%, $P=0.04$) in patients with type 1 DM. CRVO patients with type 1 DM were nearly twice as likely to undergo subsequent PRP as compared with patients with type 2 DM (78.6 *vs* 41.9%, $P=0.01$). However, visual outcomes between type 1 and type 2 DM patients with CRVO were not significantly different (initial visit, $P=0.11$; follow-up visit, $P=0.36$; final visit, $P=0.68$).

Discussion

DR and retinal vein occlusions are among the most common vascular disorders affecting the retina.[29] There are many factors common to both these disorders: older age, hypertension, hyperlipidemia, and coagulation disorders. Both have similar treatment options including PRP and intravitreal injections of vascular endothelial growth factor inhibitors. Studies focusing on vitreous factors mediating these disorders have shown increased expression of similar proteins[30,31] and it is likely that both CRVO and DR share similar pathogenic mechanisms in relation to the final pathways resulting in retinal neovascularization.

Previously reported prevalence of CRVO overall ranges from 0.1%[4] to 0.8%.[5] In the current study, the prevalence of 0.5% is consistent with prior reports. Although patients with CRVO have a higher prevalence of DM than the general population,[16,21–24] in the current study the prevalence of CRVO in DM patients was 0.5%, and was not statistically different than the prevalence of 0.4% observed in the nondiabetic patients. The similarity between these two groups may reflect the academic diabetes-specific tertiary care medical center referral setting in which this study was conducted. Older age has been associated with increasing prevalence of CRVO[6,7] as well as more ischemic CRVO in the general population.[32] Potentially, diabetes itself does not increase the risk of developing CRVO.[33] In this study, there was no statistical difference in the mean age of CRVO patients with DM as compared with nondiabetic patients with CRVO. However, patients with DM and CRVO were significantly older compared with the overall cohort of DM patients reviewed in the study, consistent with increasing age being a risk factor for CRVO. Consistent with previous studies,[25,34] we observed that DM patients with CRVO developed retinal neovascularization (particularly NVD) more frequently than nondiabetic patients with CRVO. Increased risk of neovascularization would be consistent with the generally increased state of retinal ischemia in the diabetic patient.

Interestingly, DM type had a substantial impact on CRVO anatomic outcomes. There was more than an eightfold increased risk of developing neovascularization and a twofold greater rate of receiving PRP in type 1 DM patients as compared with type 2 DM patients. This finding is consistent with the generally greater risk of neovascular complications observed in type 1 compared with type 2 DM patients in population- and clinic-based reports.[35] Optic nerve head CVs were observed less than half as often in patients with type 1 DM and the presence of these CVs at baseline was associated with a more than threefold reduction in PRP. However, visual outcomes between type 1 and type 2 DM patients with CRVO were not significantly different, likely as a result of the effectiveness of current treatment regimens and limited number of events in specific subgroups.

The role of retinochoroidal CVs on the natural history of CRVO is unclear. Some studies report that the development of CVs may be associated with a better visual prognosis in patients with CRVO. However, Hayreh *et al* suggested that CVs formation may be associated with a delay in resolution of macular edema and worse prognosis.[9] Recent data from the SCORE study may indicate that the development of venous collaterals does not demonstrate an independent association with visual acuity in eyes with CRVO.[36] Although limited to only 15 instances of CV formation, our data did not demonstrate a significant difference in the incidence of collateral formation following CRVO in patients with or without DM.

Although the number of eyes identified in this study that developed CRVO was relatively small (104 eyes of 99 patients), a total of 19 648 patients (13 571 with DM) were evaluated over nearly a 5-year period. Thus, this study represents one of the largest reports of DM patients with CRVO (76 eyes) and one of the only studies to specifically report on diabetes type. Comparatively, the Central Vein Occlusion Study (CVOS), which established the guidelines for panretinal laser photocoagulation in

Table 5 Prevalence of neovascularization and retinochoroidal collateral formation in patients with CRVO.

	CRVO eyes	*CRVO eyes with DM*	*CRVO eyes without DM*	P-*value*[a]
Any neovascularization	44.44% (32)	49.09% (27)	29.41% (5)	0.15
Rubeosis (NVI and/or NVA)				
Any visit	28.99%	30.77%	23.53%	0.57
Baseline	3.85%	5.26%	0.00%	0.22
4-month follow-up	17.91%	20.00%	11.76%	0.44
Last visit	12.62%	13.33%	10.71%	0.72
Neovascularization of the disc				
Any visit	16.13%	21.28%	0.00%	0.05
Baseline	4.85%	6.67%	0.00%	0.16
4-month follow-up	8.96%	12.00%	0.00%	0.13
Last visit	3.16%	4.41%	0.00%	0.27
Neovascularization elsewhere				
Any visit	12.90%	14.89%	6.67%	0.41
Baseline	3.88%	5.33%	0.00%	0.21
4-month follow-up	2.99%	2.00%	5.88%	0.42
Last visit	3.16%	4.41%	0.00%	0.27
Neovascular glaucoma				
Any visit	10.94%	12.77%	5.88%	0.44
Baseline	1.94%	2.67%	0.00%	0.38
4-month follow-up	2.94%	2.00%	5.56%	0.44
Last visit	7.14%	8.57%	3.57%	0.39
Optic nerve head CVs				
Any visit	51.35%	48.08%	59.09%	0.39
Baseline	13.59%	12.00%	17.86%	0.44
4-month follow-up	11.76%	10.00%	16.67%	0.45
Last visit	35.79%	30.88%	48.15%	0.11

Abbreviations: CRVO, central retinal vein occlusion; CV, collateral vessel; DM, diabetes mellitus; NVA, neovascularization of the angle; NVI, neovascularization of the iris.
[a]*P*-value comparing CRVO eyes with DM to CRVO eyes without DM.

patients with CRVO, enrolled only five patients with diabetes in each study arm.[27] The Beaver Dam population-based study evaluated 4068 patients over a 15-year period and reported only 62 incident CRVO cases.[6] The more recent SCORE study enrolled 62 diabetes CRVO patients.[37] In none of these reports was diabetes type specifically evaluated.

The retrospective nature of the current study is a limitation; however, the drawbacks inherent in this study design are mitigated in this particular case by evaluation of the entire patient population over the period, use of standardized diabetes-specific electronic medical record with comprehensive diabetes and systemic history, standardized refraction and visual acuity measurement, study-certified data acquisition personnel, and uniform retinopathy grading. Fluorescein angiograms were only obtained in a subset of patients, which is a limitation of the study; however, the baseline demographic did not significantly differ in eyes that had an angiogram performed at baseline as compared with eyes that did not have an angiogram. Furthermore, the available angiograms were evaluated based on SCORE study criteria that was previously demonstrated to be a reproducible assessment of retinal vascular leakage severity and capillary nonperfusion.[38]

In conclusion, this study suggests not only that DM increases the likelihood of retinal neovascularization and the need for PRP in patients with CRVO, but also that diabetes type is an important indicator of key ocular outcomes. Patients with type 1 DM were at eightfold higher risk for developing neovascularization following CRVO as compared with patients with type 2 DM, and twice as likely to receive PRP and half as likely to develop optic nerve head CVs. These data suggest that following CRVO, patients with type 1 DM should be followed especially carefully for development of retinal complications and need for treatment. However, given current care approaches, visual acuity outcomes are similar following CRVO for type 1 DM, type 2 DM, and nondiabetic patients.

Summary

What was known before

- Following diabetic retinopathy, central retinal vein occlusion (CRVO) is the most frequently occurring retinal vascular disease with estimated prevalence of between 0.1% and 0.8% and a 15-year cumulative incidence of 0.5%. The development of retinal ischemia is primarily responsible for the ocular complications in CRVO.
- Patients with diabetes are thought to have an increased risk for developing CRVO. However, little is known regarding how diabetes and diabetes type contribute to retinal outcomes in CRVO.

What this study adds

- Our data on over 19 000 patients show that diabetes and diabetes type significantly influence ocular outcomes in patients with CRVO.
- Diabetes was associated with increased risk of retinal neovascularization and the need for panretinal laser photocoagulation (PRP) following CRVO. Furthermore, patients with type 1 diabetes were at eightfold higher risk for developing neovascularization, twice as likely to receive PRP and half as likely to develop optic nerve head collateral vessels following CRVO as compared with patients with type 2 diabetes and CRVO. Nevertheless, final visual acuity outcomes were similar.

Conflict of interest

The authors declare no conflict of interest.

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Medscape EDUCATION

Influence of diabetes and diabetes type on anatomic and visual outcomes following central rein vein occlusion

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1. According to the retrospective chart review by Dr. Santiago and colleagues, which of the following statements about the prevalence of central retinal vein occlusion (CRVO) in diabetic and nondiabetic patients is ***correct***?

A The prevalence of CRVO was 0.5% in diabetic patients and 0.4% in nondiabetic patients

B In this cohort, rates of CRVO in diabetic and nondiabetic patients were significantly higher than those in previously published population-based studies

C Coexisting diabetes has been reported in more than half of patients with CRVO

D Prevalence of bilateral CRVO was significantly higher in diabetic vs nondiabetic patients

2. Your patient is a 66-year-old man with type 1 diabetes and CRVO. According to the retrospective chart review by Dr. Santiago and colleagues, which of the following statements about ocular outcomes after CRVO in diabetic vs nondiabetic patients is ***correct***?

A Disc neovascularization occurred in 30% of diabetic patients and 12% of nondiabetic patients

B Nearly half (48.7%) of diabetic patients underwent panretinal photocoagulation (PRP)

C Rates of PRP were not significantly different in diabetic vs nondiabetic patients

D Diabetic patients had significantly worse visual acuity than nondiabetic patients

3. According to the retrospective chart review by Dr. Santiago and colleagues, which of the following statements about ocular outcomes after CRVO in patients with type 1 diabetes vs those with type 2 diabetes would ***most*** likely be correct?

A Compared with patients with type 2 diabetes, those with type 1 were at twice the risk for the development of neovascularization

B Compared with patients with type 2 diabetes, those with type 1 were not significantly more likely to need PRP

C Final visual acuity outcomes were significantly worse in patients with type 1 diabetes vs those with type 2 diabetes

D After CRVO, patients with type 1 diabetes should be monitored closely for development of retinal complications and need for treatment

Activity evaluation

1. The activity supported the learning objectives.

Strongly disagree				Strongly agree
1	2	3	4	5

2. The material was organized clearly for learning to occur.

Strongly disagree				Strongly agree
1	2	3	4	5

3. The content learned from this activity will impact my practice.

Strongly disagree				Strongly agree
1	2	3	4	5

4. The activity was presented objectively and free of commercial bias.

Strongly disagree				Strongly agree
1	2	3	4	5