SZCZEŚNIAK, Grzegorz, KIEŁCZEWSKA, Aleksandra and KIEŁCZEWSKA, Anna. Central Retinal Vein Occlusion: Etiology, Clinical Presentation and Treatment. Journal of Education, Health and Sport. 2025;79:58740. eISSN 2391-8306.
https://doi.org/10.12775/JEHS.2025.79.58740
https://apcz.umk.pl/JEHS/article/view/58740

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).
Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).
The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 23.01.2025. Revised: 02.03.2025. Accepted: 02.03.2025. Published: 03.03.2025.

Central Retinal Vein Occlusion: Etiology, Clinical Presentation and Treatment

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ABSTRACT

Introduction and Purpose: Retinal vein occlusion (RVO) occurs when the lumen of the retinal vein closes. Central retinal vein occlusion is the second most common retinal vascular disease. There are distinguished forms: central retinal vein occlusion (CRVO), hemiretinal vein occlusion (HRVO) and branch retinal vein occlusion (BRVO). Central retinal vein occlusion is a prevalent cause of visual impairment among the elderly. Currently, there are no proven methods for the prevention of this condition. Current therapy is based on treatment of possible complications (laser therapy, anti-VEGF injections, glucocorticosteroid injections). Central retinal vein occlusion (CRVO) is a disease that involves the sudden appearance of lesions on the fundus due to the closure of a venous vessel. As a result, the patient often experiences a significant deterioration in visual acuity, potentially leading to complete vision loss. Determining the epidemiology is difficult, and diagnosis is based mainly on a physical examination combined with a thorough ophthalmologic evaluation, supplemented by a number of additional tests.

Materials and Methods: A comprehensive survey of articles published in scientific journals was conducted via the online research platforms PubMed and Google Scholar. Articles were searched by entering keywords in the appropriate configuration: “retinal vein occlusion”, “retina”, “visual impairment”.

Description of current knowledge: Studies have indicated that the approach to diagnosing and managing central retinal vein occlusion is largely contingent on the underlying cause and the intensity of the patient's symptoms.

Keywords: “retinal vein occlusion”, “retina”, “visual impairment”

Introduction: Retinal vein occlusion is a prevalent cause of visual impairment among patients seen by ophthalmologists. The two variants of central retinal vein occlusion are the ischemic and non-ischemic subtypes. The non-ischemic form is more common, occurring in approximately 75-80% of CRVO patients. Conversely, the ischemic subtype, while less prevalent, tends to have a more severe course and can result in vision loss. In the general population, central retinal vein occlusion is the second most common retinal vascular disease. The development of a thrombus within the vein may be linked to atherosclerotic changes in the central retinal artery. Thrombotic obstruction of the central retinal vein lumen can arise from various pathological processes, including venous compression, hemodynamic disturbances, and inflammation of the retinal vessels. Central retinal vein occlusion is a condition characterized by the sudden development of lesions on the fundus due to venous obstruction, frequently accompanied by macular edema, dilated and tortuous venous vessels, intraretinal hemorrhages, and impaired capillary perfusion [1]. Fluorescein angiography is a critical diagnostic procedure that visualizes the retinal circulation and identifies areas of impaired perfusion. Retinal edema in angiography appears as diffuse hyperfluorescence

persisting throughout the late stages. Additionally, optical coherence tomography examination of the macula and optic nerve is essential. Central retinal vein occlusion is a chronic, recurrent condition, making effective treatment challenging. Historically, photocoagulation of ischemic areas has been utilized to suppress VEGF production. While laser therapy continues to be a well-recognized approach, in recent times, with enhanced comprehension of the pathogenesis of retinal vein occlusion, pharmacological interventions to mitigate its detrimental consequences have gained increasing favor. Consequently, intravitreal VEGF inhibitors and injectable corticosteroids are commonly employed. In cases of severe, complex central retinal vein occlusion, surgical management, particularly vitrectomy, is often warranted.

Etiology

Central retinal vein occlusion frequently occurs in the elderly population and is often associated with systemic vascular diseases such as hypertension, diabetes mellitus, and arteriosclerosis [2]. The major cardiovascular risk factors that have been associated with and contribute to the development of central retinal vein occlusion include hypertension, ischemic heart disease, hyperlipidemia, and diabetes mellitus. Less common risk factors include hyperhomocysteinemia, obesity, and smoking [3][4][5][6]. According to population-based studies, the incidence of central retinal vein occlusion ranges from 2 to 8 cases per 1,000 individuals per year, and the incidence increases with advancing age [7][8]. Central retinal vein occlusion is most prevalent in the 60-70 age group, but it can occur across a wide range of ages. Patients under 50 years old account for approximately 10% of cases.[9] Approximately 90% of retinal vein occlusion patients are aged 50 years or older, according to estimates [10]. In younger patients, central retinal vein occlusion may be linked to an underlying hypercoagulable state or inflammatory conditions [11]. Risk factors for retinal vein occlusion can be categorized into two broad groups: systemic and local factors [12][13]. Research indicates that in 5-11% of cases, central retinal vein occlusion is subsequently diagnosed in the unaffected eye within 5 years of the initial incident [14][9].

Systemic factors:

The risk of central retinal vein occlusion rises significantly with advanced age, particularly in individuals over 65 years old, accounting for more than half of all cases. Moreover, chronic medical conditions such as hypertension, diabetes, obesity, and elevated blood lipid levels, in addition to smoking, have been found to greatly increase the probability of developing CRVO. Furthermore, inflammatory disorders leading to vasculitis, including sarcoidosis, Behçet's disease, Wegener's granulomatosis, and Goodpasture's syndrome, have also been associated with an increased risk of CRVO. Additional risk factors include conditions associated with increased blood viscosity[15][16], such as polycythemia vera or myeloma, as well as coagulation disorders, such as hyperhomocysteinemia or antiphospholipid syndrome[17][18]. Congenital defects in the coagulation system, including genetic mutations (such as factor V Leiden or the G20210 mutation in the prothrombin gene), also play a significant role. Deficiencies in natural anticoagulants, such as antithrombin[19], protein C and S, and fibrinolysis disorders, such as plasminogen deficiency or increased activity of certain coagulation factors, further increase the risk. Pregnant women and those using oral contraception are also at risk.

Local factors:

Local factors directly affecting the eye, such as conditions like glaucoma or hyperopia, can increase stress on the retinal vasculature. Similarly, intraocular inflammation, vascular compression, or vascular kinking may also contribute to thrombus formation. Notably, cases involving abnormal interactions between arterial and venous vessels, particularly when arteries cross over veins, warrant special consideration due to the potential for mechanically disrupted blood flow. Antecedent ocular trauma has been observed in a subset of patients prior to the development of central retinal vein occlusion [20]. In certain instances, the presence of drusen or optic disc edema may be associated with central retinal vein occlusion [21][22]. Certain cases have reported an association between central retinal vein occlusion and the presence of an arteriovenous fistula in the cavernous sinus region [23].

Atherosclerosis is a major contributing factor of central retinal vein occlusion or its branches.

The stiffening of arterial walls accompanying this condition leads to narrowing of the venous vessel lumen, particularly at the junctions where arteries and veins share a common sheath. Furthermore, when an arterial vessel is positioned superior to a venous vessel, the risk of thrombosis is elevated. The primary mechanisms underlying thrombus formation are the turbulence of blood flow within the constricted vessels and endothelial damage resulting from hypoxia. Conversely, the development of macular edema and hemorrhages is attributed to flow disturbances, increased blood pressure, and ischemia [24]. The resultant increase in venous pressure leads to the exudation of fluid, lipids, and blood into the retina, which can ultimately result in vision loss [25]. Retinal vascular diseases, including diabetic retinopathy, neovascular age-related macular degeneration, and retinal vein occlusion, are leading causes of blindness in the Western world [26].

Diagnosis

In the non-ischemic presentation, initial symptoms include blurred and deteriorating vision, which typically resolve without any intervention. Conversely, the ischemic form is characterized by a sudden decline in visual acuity. Ophthalmoscopic examination of patients with the ischemic central retinal vein occlusion reveals dilated and tortuous retinal veins, as well as scattered round or petechial hemorrhages that are more predominant at the peripheral fundus. Additionally, optic disc swelling and impaired capillary perfusion are also characteristic in the non-ischemic presentation condition. Fluorescein angiography demonstrates delayed vascular filling, while ischemic CRVO is further characterized by a reduced electroretinographic response and impairment of the pupillary light reflex.

The onset and severity of visual impairment associated with central retinal vein thrombosis can vary significantly. This is influenced not only by the location of the vein obstruction, but also by the overall condition of the vasculature and the ability of the affected tissues to adapt to the reduced oxygen and nutrient supply until the circulation can "self-repair". While spontaneous repair is possible, it occurs infrequently. The natural progression of central retinal vein occlusion involves gradual visual deterioration over time. Patients with the ischemic form of CRVO exhibit poorer initial visual acuity and experience a more rapid decline in visual function. Furthermore, the non-ischemic form of CRVO progresses to the ischemic form in 34% of patients within 3 years. Interestingly, in 30% of patients with non-ischemic CRVO, macular edema resolves spontaneously over time [27].

Examination

The diagnostic evaluation for suspected central retinal vein occlusion necessitates a comprehensive approach, which encompasses the assessment of fundamental parameters and a detailed ophthalmologic examination to identify potential complications and determine the severity of the condition. The initial step involves evaluating visual acuity to ascertain the degree of visual impairment and its impact on the patient's daily functioning. Subsequently, intraocular pressure is measured, as its elevation may indicate the presence of glaucoma or other complications, such as iris neovascularization. Slit-lamp examination facilitates a thorough assessment of the anterior segment of the eye, which is crucial for detecting abnormal new vessel formation within the iris. This examination holds particular significance in cases of ischemic central retinal vein occlusion, where the risk of neovascularization is considerably higher. The next step is gonioscopy, which should be conducted before pupil dilation. This procedure allows for the evaluation of the angle of infiltration, which is especially important in instances of elevated intraocular pressure or increased risk of neovascularization. Gonioscopy plays a crucial role in the early detection of lesions that may lead to glaucoma.

Diagnostic tests

The diagnostic evaluation for retinal disorders, including central retinal vein occlusion, necessitates the utilization of various imaging modalities to accurately assess the condition of the eye's structures and the extent of pathological changes. The initial step involves obtaining a color fundus photograph, which serves to document existing retinal lesions. This photographic record enables the visualization of focal edema, hemorrhages, and other abnormalities within the retina, providing a reference point for subsequent monitoring of the disease progression. Fluorescein angiography is then performed, allowing for the assessment of the degree of retinal vascular occlusion and the identification of areas of ischemia or neovascularization. This procedure facilitates the determination of the extent of blood vessel damage and the intensity of retinal ischemia. Further diagnostic evaluation is supplemented

by Optical Coherence Tomography, which is employed to detect detailed changes in the macula, such as edema or structural abnormalities within the retinal layers. OCT plays a crucial role in assessing the severity of the disease and the impact of the pathology on central vision. In instances where the visibility of the fundus is restricted, such as due to vitreous hemorrhage, ultrasonography becomes a valuable tool. This examination enables the assessment of intraocular structures despite the presence of optical obstructions, and allows for the identification of other potential pathologies, including retinal detachment.

This comprehensive diagnostic strategy enables accurate identification of ocular lesions, evaluation of complication risks, and implementation of suitable treatment interventions.

Treatment

Addressing underlying cardiovascular conditions or concurrent eye diseases does not prevent the detrimental effects of retinal vein occlusion on visual acuity [28]. However, it is possible to mitigate the progression of the disease from a ischemic to an non-ischemic form, and decrease the recurrence rate or the risk of involvement in the fellow eye [29]. The management of central retinal vein occlusion involves a multifaceted approach that addresses both risk factor control and the implementation of modern therapeutic interventions. The cornerstone of prevention is the effective treatment of underlying conditions such as diabetes, hypertension, and hyperlipidemia [30]. Optimizing the control of these risk factors can significantly reduce the risk of central retinal vein occlusion and its associated complications. In cases where CRVO has already occurred, anti-VEGF agents are considered the gold standard for treating the associated macular edema in both central retinal vein occlusion and branch retinal vein occlusion. Numerous studies, including randomized controlled trials, have demonstrated the high efficacy of these agents in reducing edema and improving visual acuity [31]. Alternatively, or as an adjunct to anti-VEGF therapy, intravitreal injections of corticosteroids like triamcinolone or dexamethasone have also shown efficacy in reducing macular edema in CRVO. However, the use of corticosteroids is associated with the risk of side effects, such as cataract development and increased intraocular pressure leading to glaucoma. In advanced cases, where complications like iris rubeosis or vitreous hemorrhage occur, sectoral panretinal photocoagulation is recommended to prevent further neovascularization and reduce ischemic complications. Given the complexity of CRVO

diagnosis and treatment, the patient's healthcare provider should be well-versed in the current guidelines and clinical trial outcomes to individualize the therapy and provide the patient with the most appropriate care based on the available scientific evidence.

Caring for patients with central retinal vein occlusion necessitates regular monitoring and dynamic adjustment of treatment based on evolving symptoms and therapeutic response. Ongoing ophthalmological follow-up is crucial, enabling continuous assessment of treatment progress and modification of management strategies as required. In addition to managing ophthalmic therapy, the ophthalmologist should collaborate with the primary care physician, referring the patient for evaluation and treatment of coexisting systemic conditions, such as hypertension, diabetes, and lipid disorders. Consistent communication of test results and recommendations between specialists is essential to ensure comprehensive patient care. It is also vital that the patient and primary care provider are cognizant of the risk of blood clots or complications in the fellow eye. Early recognition and appropriate preventive measures can mitigate serious complications and improve prognosis. Thus, holistic care for patients with central retinal vein occlusion encompasses both ophthalmological treatment and coordination with other specialists, as well as support for permanent visual impairments.

Summary: Central retinal vein occlusion represents a significant diagnostic and therapeutic challenge in ophthalmology, necessitating a multidisciplinary approach. Early identification and management of underlying systemic risk factors, such as hypertension, diabetes mellitus, and hyperlipidemia, play a crucial role in both prevention and mitigation of complications. For the treatment of macular edema associated with CRVO, anti-VEGF agents and intravitreal corticosteroid injections have demonstrated efficacy, although the latter carries a risk of side effects. In cases of advanced lesions, including iris neovascularization or vitreous hemorrhages, sectoral panretinal photocoagulation remains an effective therapy. It is essential for ophthalmologists to collaborate closely with primary care providers and offer visual rehabilitation support to patients who experience permanent visual impairment. A holistic approach, grounded in current guidelines and clinical research, is pivotal in optimizing treatment outcomes and enhancing the quality of life for individuals affected by CRVO.

Funding

This research did not receive any funding.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Not applicable.

Conflict of interest

The authors report no conflicts of interest.

Statement of the authors' contribution

Grzegorz Szcześniak: Conceptualization, Writing-rough preparation

Aleksandra Kiełczewska: Methodology, Investigation Resources

Anna Kiełczewska: Formal analysis, Visualisation, Writing-review and editing

All authors have read and approved the published version of the manuscript.

References

[1] “Hayreh S., Prevalent misconceptions about acute retinal vascular occlusive disorders, „Prog Retin Eye Res”2005; 24: 493–519.,”

[2] N. Bhagat, M. F. Goldberg, P. Gascon, W. R. Bell, J. Haberman, and M. A. Zarbin, “Central Retinal Vein Occlusion: Review of Management,” European Journal of Ophthalmology, vol. 9, no. 3. SAGE Publishing, p. 165, Jul. 01, 1999. doi: 10.1177/112067219900900304.

[3] “Hayreh SS, Zimmermann B, McCarthy MJ, Podhajsky P. Systemic diseases associated with various types of retinal vein occlusion. Am J Ophthalmol 2001; 131: 61–77.,”

[4] “Elman MJ, Bhatt AK, Quinlan PM, Enger C. The risk for systemic vascular diseases and mortality in patients with central retinal vein occlusion. Ophthalmology 1990; 97: 1543–1548.,”

[5] “The Central Retinal Vein Occlusion Study Group. Risk factors for central retinal vein occlusion. Arch Ophthalmology 1996; 114: 545–554.,”

[6] “Sperduto RD, Hiller R, Chew E, et al. Risk factors for hemiretinal vein occlusion: comparision with risk factors for central and branch vein occlusion: the eye disease case-control study. Ophthalmology 1998; 105: 765–771.,”

[7] “Klein R, Klein BE, Moss SE, et al. The epidemiology of retinal vein occlusion: Beaver Dam Eye Study. Trans Am Ophthalmol 2000; 98: 133–141.,”

[8] “David R, Zangwill L, Badarna M, et al. Epidemiology of retinal vein occlusion and its association with glaucoma and increased intraocular pressure. Ophthalmologica 1988; 197: 69.,”

[9] “Brown GC. Central retinal vein obstruction: diagnosis and management. In: Reinicke RD (ed). Ophthalmol Annual 1985; 1: 65–97.,”

[10] “Klein R., Klein B.E., Moss S.E., Meuer S.M., The epidemiology of retinal vein occlusion: the Beaver Dam EyeStudy, „Trans Am Ophthalmol Soc”, 2000; 98: 133–143.,”

[11] A. C. O. Fong and H. Schatz, “Central retinal vein occlusion in young adults,” Survey of Ophthalmology, vol. 37, no. 6. Elsevier BV, p. 393, May 01, 1993. doi: 10.1016/0039-

6257(93)90138-w.

[12] “Hamid S., Mirza A., Shokh I., Branch retinal vein occlusion, „Journal of Ayub Medical College Abbottabad”2008;20[2]; 128–32.,”

[13] “Kubicka-Trząska A., Romanowska-Dixon B., Diagnosis and management of retinal venous and arterial occlusive disease, „Przew Lek” 2010; 2: 159–164.,”

[14] “Hayreh SS, Zimmerman MB, Podhajsky P. Incidence of various types of retinal vein occlusion and their recurrence and demographic characteristics. Am J Ophthalmol 1994; 117: 429–441.,”

[15] “Wiek J, Schade M, Wiederholt M, et al. Haemorheological changes in patients with retinal vein occlusion isovolaemic haemodilution. Br J Ophthalmol 1990; 74: 665–669.,”

[16] “Arend O, Remky A, Jung F, et al. Role of rheologic factors in patients with acute central retinal vein occlusion. Ophthalmology 1996; 103: 80–86.,”

[17] “Asherson RA, Merry P, Acheson JF, et al. Antiphospholipid antibodies: a risk factor for occlusive ocular vascular disease in systemic lupus erythematosus and the ‘primary’ antiphospholipid syndrome. Ann Rheum Dis 1989; 48: 358–361.,”

[18] “Glacet-Bernard A, Bayani N, Chretien P, et al. Antiphospholipid antibodies in retinal vascular occlusions. A prospective study of 75 patients. Arch Ophthalmol 1994; 112: 790–795.,”

[19] “Abu el-Asar AM, al-Momen AK, al-Amro S, et al. Prothrombotic states associated with retinal venous occlusion in young adults. Int Ophthalmol 1996–1997; 20: 197–204.,”

[20] “McGarth MA, Wechsler F, Hunyor ABL, Penny R. Systemic factors contributory to retinal vein occlusion. Arch Int Med 1978; 138: 216–222.,”

[21] “Ten Doesschate MJL, Manschot WA. Optic disc drusen and central retinal vein occlusion. Documenta Ophthalmol 1985; 59: 27–31.,”

[22] “Galvin R, Sanders MD. Peripheral retinal haemorrhages with papilloedema. Br J Ophthalmol 1980; 64: 262–266.,”

[23] “Schmidt D, Schumacher M, Waklooh AK. Microcatheter urokinase infusion in central retinal artery occlusion. Am J Ophthalmol 1992; 113: 429–434.,”

[24] “Rehak J., Rehak M., Branch retinal vein occlusion: Pathogenesis, visual prognosis, and

treatment modalities„„Current Eye Research” 2008; 33: 111–31.,”

[25] X. Zhang et al., “Optical Coherence Tomography Angiography Reveals Distinct Retinal Structural and Microvascular Abnormalities in Cerebrovascular Disease,” Oct. 02, 2020, Frontiers Media. doi: 10.3389/fnins.2020.588515.

[26] N. Gahlaut, S. Suárez, Md. I. Uddin, A. Y. Gordon, S. M. Evans, and A. Jayagopal, “Nanoengineering of therapeutics for retinal vascular disease,” European Journal of Pharmaceutics and Biopharmaceutics, vol. 95. Elsevier BV, p. 323, May 29, 2015. doi: 10.1016/j.ejpb.2015.05.001.

[27] “McIntosh R.L.M., Interventions for Branch Retinal Vein Occlusion, An Evidence-Based Systematic Review, „Ophthalmology” 2007; 114: 835–846.,”

[28] “Gutman FA, Zegarra H. The natural course of temporal retinal branch vein occlusion. Trans Am Acad Ophthalmol Otolaryngol 1974; 78: 178–192.,”

[29] “Branch Vein Occlusion Study Group. Argon laser photocoagulation for macular edema in branch vein occlusion. Am J Ophthalmol 1985; 99: 218–219.,”

[30] “An Informational Guide to CENTRAL RETINAL VEIN OCCLUSION, The Angiogenesis Foundation, 2013.,”

[31] “N. Feucht, E. M. Schönbach, I. Lanzl, C. P. Lohmann, K. Kotliar, and Maier, ‘Changes in the foveal microstructure after intravitreal bevacizumab application in patients with retinal vascular disease,’ Jan. 01, 2013, Dove Medical Press. doi: 10.2147/opth.s37544.,”