Case in Point

Hypoperfusion Retinopathy

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By identifying ocular manifestations of cardiovascular conditions, physicians can avoid potentially serious outcomes in patients.

Cardiovascular diseases are some of the most common conditions found in the geriatric population. Ocular manifestations of systemic cardiovascular conditions often are the initial presentation of the systemic disease. Identifying these findings help reveal the underlying disease and prevent more serious visual and systemic complications or even death.

Hypoperfusion retinopathy can occur as an early manifestation of carotid occlusive disease. It results from poor arterial perfusion pressure secondary to significant or complete carotid artery blockage resulting in retinal changes. Atherosclerotic disease is generally the main culprit. Early manifestations can be seen as midperipheral retinal hemorrhages, dilated often nontortuous veins, and retinal neovascularization. Untreated or advanced cases of carotid occlusive disease can lead to a more serious ocular ischemic syndrome, which encompasses a panocular ischemia and can result in severe vision loss and neovascular glaucoma. Restoration of arterial perfusion pressure is the main goal for managing this condition.

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CASE REPORT

A 71-year-old white male was referred by his primary care physician (PCP) to the eye clinic for a routine comprehensive eye exam. The patient reported that his current progressive lenses, prescribed 2 years prior, were not strong enough at both distance and near, and that his eyes often felt dry. The symptoms were gradual in onset since his prior exam with no reported flashes, floaters, loss of vision, headaches, or ocular irritations.

The patient's medical history was significant for morbid obesity, hypertension, borderline diabetes mellitus, and obstructive sleep apnea. His ocular history included recurrent conjunctivitis. At the time of the visit, the patient's medications included 81 mg aspirin, 10 mg benazepril, 1,000 mg fish oil, 80 mg simvastatin, and use of a continuous positive airway pressure machine.

Best-corrected Snellen visual acuity was stable to his last eye exam at $20/25^{+2}$ right eye and $20/25^{-1}$ left eye with a manifest refraction of +2.25-0.75 × 077, and +2.75-1.25 × 096 in the right and left eye, respectively. Pupils were equally round and reactive to light with no afferent pupillary defect. Extraocular motility and finger counting fields were unremarkable. Anterior segment evaluation revealed lax bilateral upper lid apposition and mild cataracts in both eyes but were otherwise unremarkable (Figure 1). Dilated fundus examination revealed extensive hemorrhaging in the midperipheral retina of the right eye only (Figure 2). The left eye retina showed no abnormalities.

At this point the patient declined any additional symptoms, including eye pain, headache, transient vision loss, jaw claudication, and stroke signs. A complete blood count and hemoglobin A_{1c} (HbA_{1c}) was ordered, and all findings were unremarkable with no evidence of blood dyscrasia and with a HbA_{1c} of 6.0. A carotid ultrasound (CUS) was also performed and revealed severe narrowing of the proximal section of the right internal carotid artery (ICA) with a trickle flow (Figure 3). The peak systolic velocity (PSV) at this level was 508 cm/s. There also was severe narrowing and turbulent flow in both the mid and distal portions of the right ICA. The patient was sent for a vascular evaluation 2 days following the CUS.

Based on the ocular findings and CUS results, the diagnosis of hypoperfusion retinopathy secondary to carotid occlusive disease was made. Because the patient was asymptomatic with no additional ocular sequelae, he was scheduled for an eye clinic follow-up in 2 months. The

electrocardiogram, chest X-ray, and exercise stress test results were negative for acute cardiopulmonary disease, ischemia, or arrhythmias. A computed tomography angiography was performed and confirmed a high-grade lesion of the right ICA of > 95%. The vascular surgeon reported an 11% risk of stroke within 5 years and a 1% risk of stroke with surgery. Based on these results the patient underwent a right carotid endarterectomy (CEA) 2 weeks later. A follow-up CUS was performed 1 month post-CEA and revealed no abnormal fluid or significant plaque with a PSV of 92 cm/s (prior to surgery PSV was 508 cm/s) (Figure 3).

The patient returned to the eye clinic 1 month after the CEA. Gonioscopy revealed no neovascularization of the iris or angle and the dilated eye exam showed resolution of the midperipheral blot hemorrhages in his right eye with no evidence of retinal neovascularization.

Figure 1. Anterior Segment Photography Postdilation

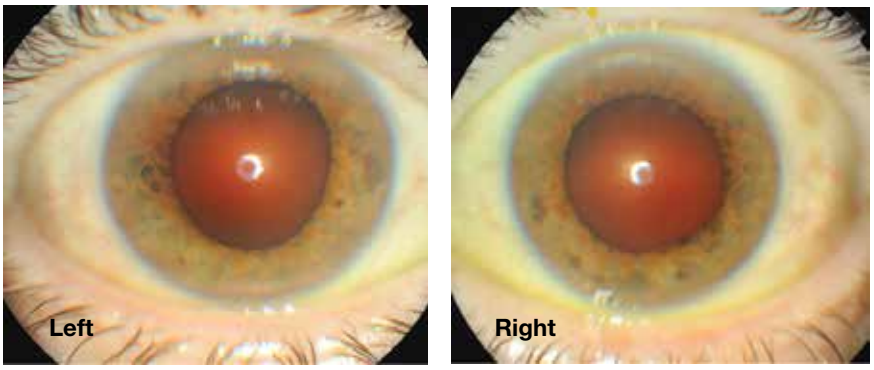
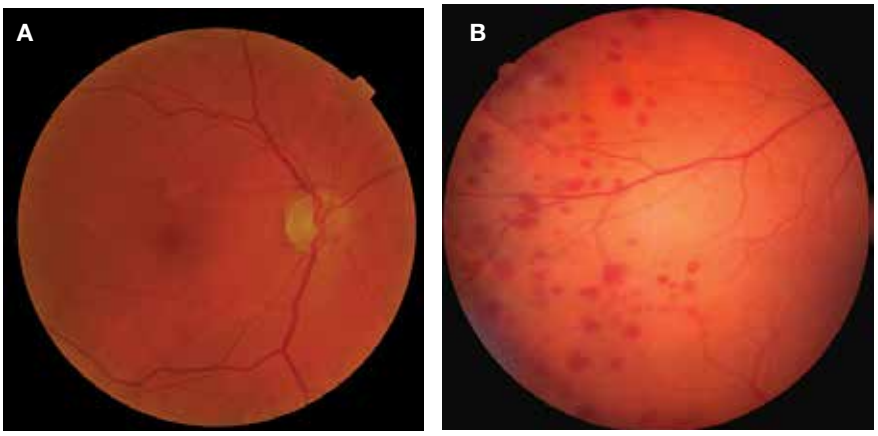


Figure 2. Right Eye Fundus Photograph



A, Posterior pole. B, Midperipheral blot hemorrhages.

DISCUSSION

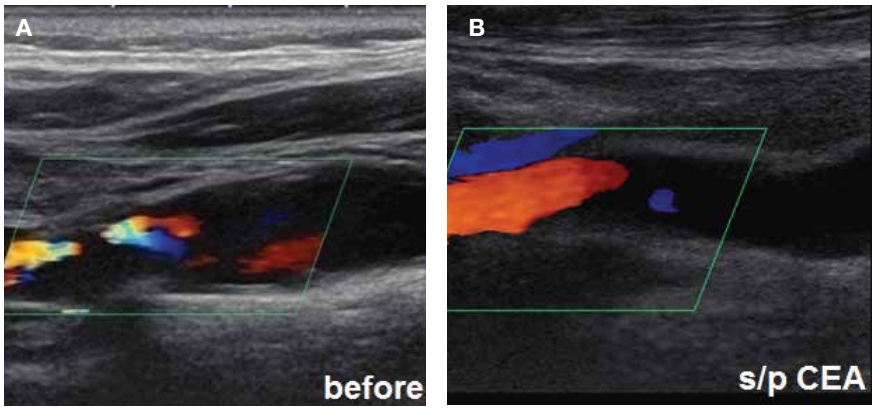
Hypoperfusion retinopathy is characterized by posterior retinal changes secondary to chronic ocular ischemia from decreased arterial perfusion related to significant or complete carotid artery stenosis.[1-5] Early literature referred to this condition as *venous stasis retinopathy*; however, this term is misleading as the condition results from a reduction in arterial perfusion pressure and the term describes venous outflow obstruction.[6] The terms *carotid ischemic retinopathy*, *ischemic oculopathy*, and *hypotensive retinopathy* also have been used interchangeably when describing hypoperfusion retinopathy.[6]

Incidence of hypoperfusion retinopathy is twice as high in males as it is in females due to a higher prevalence of cardiovascular disease.[7] Hypoperfusion retinopathy rarely presents before the age of 50 years, with the average age of onset around 65 years.[7] The exact rate of occurrence is unknown as this condition often is underdiagnosed because it mimics other vascular conditions, such as venous occlusive disease and diabetic retinopathy.[1,7] Patients can present asymptomatically where findings are incidental on a dilated eye exam, or they may present with vision loss that can be gradual, sudden, or transient in nature.[5,6,8]

Gradual vision loss can follow a period of weeks to months and can occur secondary to posterior ischemia, macular edema, or choroidal hypoperfusion.[1,3,8,9] Sudden vision loss can occur from severe hypoperfusion, creating an acute inner layer retinal ischemia. This type of vision loss often is accompanied by a cherry red spot in the macula and can be caused by an embolic plaque.[1,8] Transient vision loss (TVL) also can be secondary to a plaque emboli or light induced. Patients with light-induced TVL report poor to blurry vision or prolonged after image when exposed to bright lights. In theory when the retina is exposed to light, there is an increase in metabolic demand that is unmet in those with choroidal vascular insufficiency from significant carotid stenosis.[3,8,10]

The clinical presentation most

Figure 3. Carotid Ultrasound Doppler Image of the Proximal Right Internal Carotid Artery



A, Before surgery with a peak systolic velocity of 508 cm/s. B, After surgery with a peak systolic velocity of 92 cm/s (left).

often is unilateral. Early stages of the disease generally affect the midperipheral retina but can be found in the posterior pole with chronicity. Early findings include microaneurysms, nerve fiber layer and inner retinal layer hemorrhages, and dilated, but generally not tortuous, veins.[5] Chronic stage findings include arteriolar narrowing, extreme venous dilation, occasionally macular edema, and neovascularization of the disc and or retina.[5] Disc edema or collaterals usually are not present.[5]

The mechanism behind hypoperfusion retinopathy results from an overall ischemic cascade and starts with comorbid cardiovascular conditions, such as hypertension, hypercholesterolemia, diabetes, heart disease, and history of smoking.[1,2,5] These conditions play a role in creating atherosclerotic buildup in the arterial lumen leading to chronic narrowing and a decrease in arterial perfusion pressure. Over time, a low-grade hypoxic situation is formed, generating vascular endothelial cell damage and pericytes cell loss, thus causing leakage of fluid.[1,2,5] With these chronic hypoxic states, angiogenic factor release eventually leads to posterior neovascularization.[1,2,5] Further chronicity of carotid occlusive disease can create a panocular ischemia that also involves anterior structures, including iris, conjunctiva, episclera, or cornea. At this point, hypoperfusion retinopathy progresses to a more severe condition called ocular ischemic syndrome (OIS).[2,5]

Ocular ischemic syndrome can be associated with a 40% mortality rate within 5 years of onset as it is generally found in those with overall poor health.[5] Along with posterior neovascularization, anterior structures also are involved. Sixty-seven percent of cases have iris or angle neovascularization of which 35% go on to develop neovascular glaucoma and its complications.[1,8] With OIS, 90% of cases have some type of vision loss, and 40% report ipsilateral ocular pain.[1,8] Visual loss can be gradual, sudden, or transient. The pain can occur from ocular ischemia, ruptured corneal epithelial microcysts secondary to acute glaucoma, elevated intraocular pressure (IOP) with neovascular glaucoma, or from ipsilateral dural ischemia.[1,5,6,8] Fluorescein angiography is commonly used to diagnose and manage OIS, because it allows for the visualization of retinal and choroidal circulation and the detection of neovascular proliferation and ischemic areas.

Diagnostic Imaging

Several diagnostic testing strategies are available to evaluate for carotid occlusive disease. Carotid ultrasonography is a noninvasive, safe, and inexpensive screening tool to evaluate for high-grade stenosis. However, it can sometimes overestimate the degree of stenosis and is not reliable with severe calcifications.[8] Computed tomography angiography and magnetic resonance angiography are minimally invasive tools that can be used to screen or confirm the degree of stenosis.[8] These can be used in addition or instead of ultrasonography, especially in instances where patients have a short neck or high carotid bifurcation that may affect reliability. Both are contraindicated in those with renal failure as both modalities require the use of a contrast dye. Magnetic resonance angiography is far more expensive, time consuming, and not readily available.[8] Carotid angiography is considered the gold standard for imaging the entire carotid artery system because it allows for the evaluation of plaque morphology, atherosclerotic disease, and collateral circulations.[8] The disadvantages to this invasive and high-cost procedure include a risk of mortality that can occur secondary to an embolic stroke, myocardial infarction (MI), carotid artery dissection, or arterial thrombosis.[8]

Treatment

Treatment and management for carotid artery stenosis is focused on

combined effort with the patient's PCP and other specialists, including cardiologist, neurologist, and vascular surgeons.[11] Treatment of comorbid conditions, education on healthy lifestyle, and smoking cessation are all imperative to the patient's well-being. Managing ocular sequelae is based on specific findings and can include intravitreal antivascular edothelial growth factor or steroidal injections, pan retinal photocoagulation, or hypotensive drops.[6,7]

Restoration of arterial perfusion pressure is the main goal of treatment, and this can be done through CEA or carotid artery stents. Surgical intervention by CEA is determined based on each patient and his or her overall health. A full cardiac workup is required due to surgical risks. The North American Symptomatic Carotid Endarterectomy Trial evaluated symptomatic stenosis and the effectiveness of surgical intervention on stroke prevention. The trial reported that CEA was beneficial in symptomatic patients with 55% to 99% stenosis and especially in those with higher grade stenosis (> 70% up to 95%).[5,7,8,12] With regard to asymptomatic patients with high-grade stenosis, CEA has been found to reduce the risk of stroke if there is at least 60% stenosis.[5,7,8]

Carotid artery stents can be used as an alternative when CEA is not effective or contraindicated due to a history of previous CEA, neck radiation, unstable angina, congestive heart failure, or recent MI.[5,7,8] Neither CEA nor stenting is considered effective in complete occlusions due to the high risk of thromboembolism formation.[5,7,8]

CONCLUSION

Hypoperfusion retinopathy describes posterior retinal findings that occur secondary to poor arterial perfusion caused by carotid occlusive disease. Early intervention and restoration of this pressure can prevent the risk of developing a more serious condition characterized by a panocular ischemia called OIS. Unlike hypoperfusion retinopathy, OIS also includes anterior segment findings such as iris neovascularization, which may lead to neovascular glaucoma, whereas hypoperfusion retinopathy is localized to the posterior pole. Patients that develop OIS are at a 40% risk of mortality within 5 years due to poor overall health. Understanding the patient's signs and symptoms can aid in the diagnosis of both conditions. Collaborative management with the patient's PCP and specialists in treating comorbid conditions is vital to the patients' well-being. ●

Author disclosures

The authors report no actual or potential conflicts of interest with regard to this article.

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