



STAYING FOCUSED:

A JOURNALIST'S GUIDE TO
AGE-RELATED EYE DISEASES

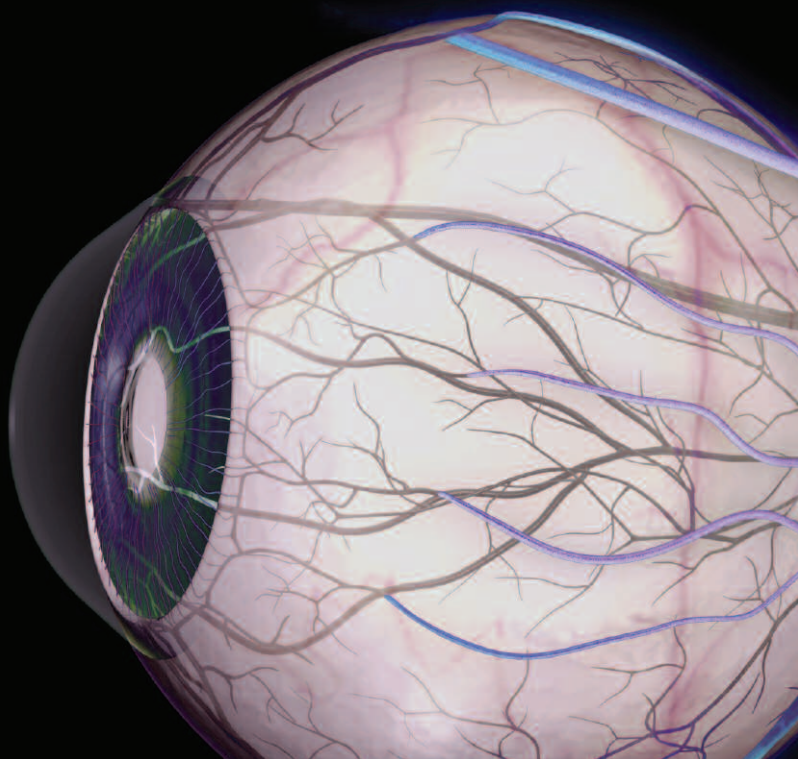


Table of Contents

- I. About the “Staying Focused” Guide1**
- II. Overview of the Eye and Blindness2**
- III. Age-Related Macular Degeneration6**
 - What is Age-Related Macular Degeneration?6
 - Risk Factors and Patient Demographics8
 - Signs and Symptoms9
 - Diagnosis10
 - Treatment11
 - Fast Facts12
- IV. Cataracts13**
 - What are Cataracts?13
 - Risk Factors and Patient Demographics14
 - Signs and Symptoms14
 - Diagnosis15
 - Treatment15
 - Fast Facts16
- V. Diabetic Eye Disease17**
 - What is Diabetic Retinopathy/Diabetic Macular Edema?17
 - Risk Factors and Patient Demographics18
 - Signs and Symptoms18
 - Diagnosis19
 - Treatment19
 - Fast Facts20

Table of Contents

- VI. Glaucoma21**
 - What is Glaucoma?21
 - Risk Factors and Patient Demographics22
 - Signs and Symptoms22
 - Diagnosis23
 - Treatment23
 - Fast Facts23

- VII. Retinal Vein Occlusion24**
 - What is Retinal Vein Occlusion?24
 - Risk Factors and Patient Demographics27
 - Signs and Symptoms28
 - Diagnosis29
 - Treatment29
 - Fast Facts30

- VIII. Media Resources31**

- IX. Image Library35**

- X. Glossary36**

- XI. Bibliography42**

About the “Staying Focused” Guide

The number of visually impaired people in the United States is expected to double during the next 30 years as the baby boomer generation ages.¹ Yet the people most at risk for developing age-related eye disease may be unaware of the factors that make them susceptible.²

Most people mistakenly assume that vision loss is part of the normal aging process. However, there is a difference between normal changes in the aging eye and those that are caused by age-related eye conditions.³

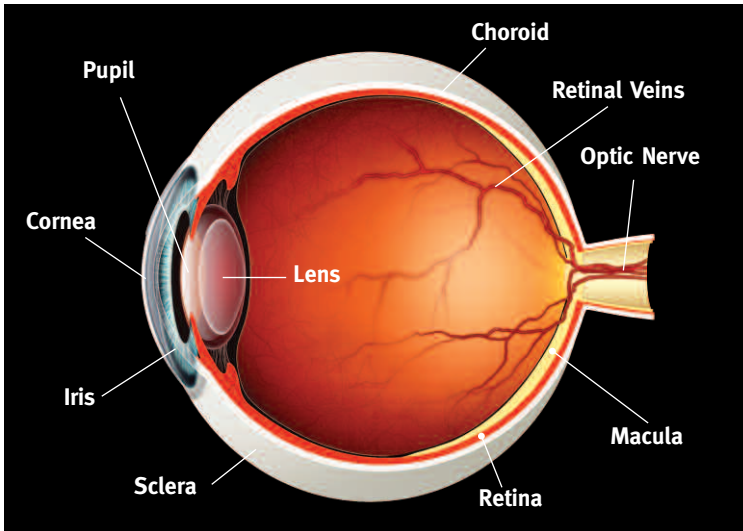
This guide is meant to serve as an easy reference for journalists writing about age-related eye diseases. It provides a comprehensive overview of the risk factors, symptoms and statistics associated with the most common eye conditions, background information and images of the eye and how it works, and a list of additional resources.

If you would like to arrange an interview with an eye expert, please contact the Genentech Media Line at (650) 467-6800.

Overview of the Eye

Introduction to the Anatomy of the Eye

FIGURE 1. ANATOMY OF THE EYE



Of all the sensory information relayed to the brain, four-fifths is visual in origin.⁴ In an instant, the eye can receive millions of pieces of information, which are quickly transmitted to and processed by the brain.⁵

This complex organ focuses light through its front portion (the cornea), then through the mid-portion (the lens), and onto the back portion (the retina). The retina relays the light signals via the optic nerve to the brain, which assembles the signals into the images called vision. (See Figure 1)

When functioning properly, the three layers of eye tissue help preserve the health of the eye. The outer layer is the sclera, a tough, opaque tissue which serves as the eye's protective outer coat. The middle layer is the choroid, a thin layer of tissue which supplies blood and transports nutri-

Overview of the Eye

ents and oxygen to the outer sclera and inner retinal tissue.⁸ The innermost layer is the retina, a transparent, light-sensitive tissue composed of color-sensitive photoreceptor cells which exit the eye at the optic nerve.⁷ Within the central area of the retina is the macula,⁷ which is responsible for central vision – the kind of vision needed to read or recognize faces.⁹

Eye Care Specialists

There are many types of specialists involved in the care of the eye, each trained in treating different conditions.

Optician

An optician is a specialist with an associate degree in opticianry. Opticians are trained in fitting eyeglasses and making lenses to correct vision problems. An optometrist or ophthalmologist performs eye examinations and writes prescriptions for corrective lenses; an optician fills that prescription.¹⁰

Optometrist

An optometrist is a doctor of optometry (O.D.), but not a medical doctor. Optometrists can examine, diagnose and manage many visual problems and eye diseases, and are specially trained to test vision in order to prescribe eyeglasses or contact lenses.¹¹ If an optometrist suspects that a more serious condition, such as retinal disease or cataracts, is present, he/she will make a referral to an ophthalmologist or retina specialist for appropriate follow-up care and treatment.¹²

Optometric Glaucoma Specialist

An optometric glaucoma specialist is a therapeutically certified optometrist – not a medical doctor – who is licensed to treat glaucoma. Most optometric glaucoma specialists complete an extra year or two of training after their residency.¹³

Overview of the Eye

Ophthalmologist

An ophthalmologist is a medical doctor (M.D.) who specializes in comprehensive eye care, including intricate eye surgery. Many ophthalmologists specialize in a particular disease or portion of the eye or condition, like cataracts.¹¹

Retina Specialist

A retina specialist is a medical doctor (M.D.), typically (but not exclusively) an ophthalmologist, who has completed additional sub-specialty fellowship training in the diagnosis and pharmaceutical, surgical, and laser treatment of retinal diseases. They frequently address the most complicated and challenging retinal diseases.¹⁴

Visual Acuity

Visual acuity refers to the clarity or sharpness of vision¹⁵ and is typically measured by an optometrist or ophthalmologist during an annual eye exam.

The term “**20/20 vision**” represents normal visual acuity. If a person has 20/20 vision, he/she can see objects clearly that are 20 feet away. If a person has a best corrected vision of 20/200, otherwise known as **legal blindness**, he/she must be as close as 20 feet to see what a person with normal vision can see at 200 feet.¹⁵

While 20/20 vision is an indication of normal visual acuity, it does not take into account other important visual skills. Peripheral awareness (side vision), eye coordination, depth perception, focusing ability and color vision also contribute to overall vision.¹⁵

Overview of the Eye

Age-Related Eye Diseases in the U.S.

Vision loss is becoming a major health problem in the U.S.¹⁶ By the year 2020, the number of Americans who are blind or have low vision in the U.S. is projected to increase substantially.¹⁷

- Blindness or low vision affects 3.3 million Americans age 40 and over, and this figure is projected to reach 5.5 million by the year 2020.¹⁶
- Low vision and blindness increase significantly with age, particularly in people over age 65.¹⁶
- People 80 years of age and older currently make up 8 percent of the population, but account for 69 percent of blindness.¹⁶
- The estimated cost of lost productivity by people who are visually impaired or blind (irrespective of age) is \$8.03 billion, including \$1.73 billion in reduced wages.¹⁸

The onset and advancement of the eye diseases discussed in this handbook are typically associated with increasing age. While the abnormalities that contribute to each disease are different, all have the potential to cause blindness.

- **Wet age-related macular degeneration (AMD)** develops when abnormal blood vessels leak and damage the macula, resulting in the loss of central vision.¹⁹
- **Cataracts** occur when the lens of the eye, which is clear or transparent when healthy, becomes clouded, causing images to become blurred.²⁰
- **Diabetic macular edema (DME)** develops in people with diabetes when retinal blood vessels deteriorate and cause the retina to swell.²¹
- **Glaucoma** occurs when fluid does not drain properly from the eye, causing a build up of pressure within the eye which can permanently damage the optic nerve.²²
- **Retinal vein occlusion (RVO)** occurs when a blood clot or other form of obstruction interferes with the normal draining of the retina, leading to hemorrhaging or swelling (edema) that causes vision loss.²³

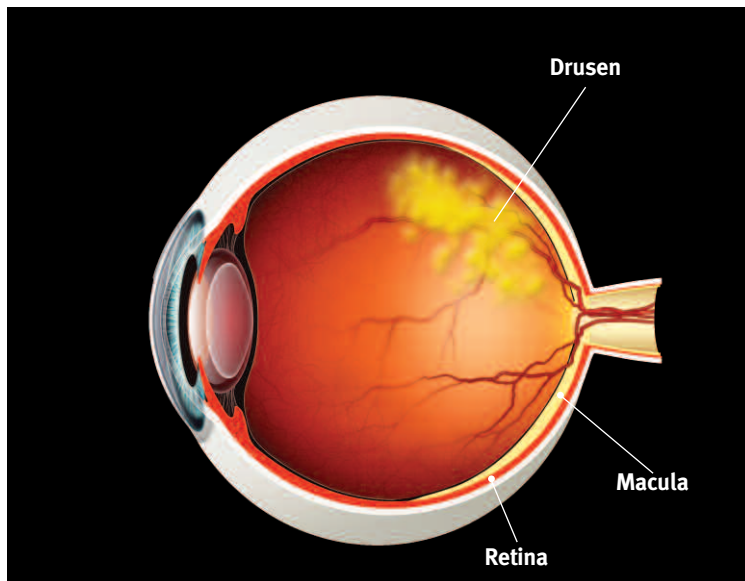
Age-Related Macular Degeneration

What is Age-Related Macular Degeneration?

Age-related macular degeneration (AMD) is characterized by a loss of function in the macula, the part of the eye responsible for central vision and the ability to see fine details clearly.¹⁹

There are two types of AMD – dry and wet.²⁴

FIGURE 2: DRY AMD MECHANISM OF DISEASE

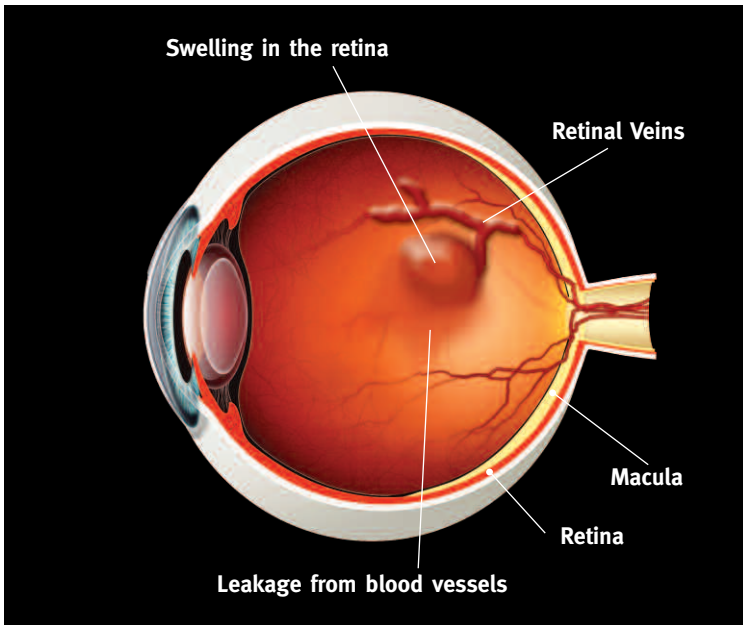


Adapted from Duke Medicine; Age-Related Macular Degeneration.

All people with AMD begin with **dry AMD**, the more common and milder form of the disease which accounts for 85 to 90 percent of all cases.²⁵ Dry AMD occurs when the light-sensitive cells in the macula slowly break down, gradually blurring central vision in the affected eye. One of the earliest signs of dry AMD is the buildup of drusen, or yellow deposits, under the retina.¹⁹ The dry form of AMD leads to significantly less vision loss than the wet form.¹⁹ (See Figure 2)

Age-Related Macular Degeneration

FIGURE 3: WET AMD MECHANISM OF DISEASE



Adapted from University of Pennsylvania Scheie Eye Institute; Age-Related Macular Degeneration.

Wet AMD, a form of advanced AMD, is thought to begin when blood vessels form abnormally at the back of the eye through a process called angiogenesis. The blood vessels leak blood or fluid in the macula and form scars that cause central vision to deteriorate and may result in permanent blind spots.²⁶ Although it represents only 10 to 15 percent of overall AMD prevalence, wet AMD is responsible for more than 80 percent of cases of severe vision loss or legal blindness in people with AMD.²⁷ (See Figure 3)

Age-Related Macular Degeneration

Risk Factors and Patient Demographics

- Age is the greatest risk factor for AMD. People over age 60 are at higher risk, and that risk increases to nearly 30 percent in people over age 75.^{19,24}
- People with immediate family members who have had AMD are at a higher risk for developing the disease.¹⁹
- AMD is more prevalent among women than men, partially because women tend to live longer.¹⁹
- The incidence of AMD is higher among Caucasians than African Americans and Asian populations.^{27,28}
- Current and past smokers are at a higher risk than those who have never smoked. Smoking may increase a person's susceptibility to genetic and environmental risk factors associated with AMD.^{19,27}
- Research has suggested a link between AMD and a diet high in saturated fat. There is also evidence that eating fresh fruits and dark green, leafy vegetables may delay or reduce the severity and progression of AMD.²⁹
- Exposure to UV light increases the risk of developing AMD.³⁰

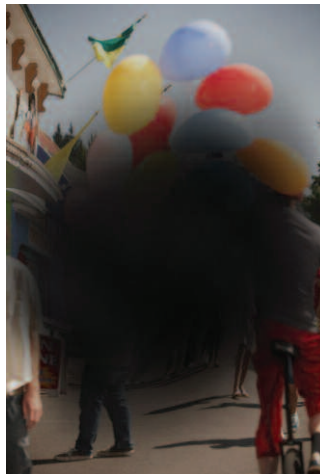
Age-Related Macular Degeneration

Signs and Symptoms

FIGURE 4. VISION THROUGH THE EYES OF A PERSON WITH WET AMD



Normal Vision – 20/20



Vision Loss
Due to Wet AMD – 20/200

In early AMD, the impact on vision is generally mild or even nonexistent. However, as the disease progresses, symptoms may include (See Figure 4):

- Blurred vision²⁷
- Blind spots in the center of the field of vision²⁷
- Colors and contrast are hard to distinguish³¹
- Lines become distorted and appear wavy³²
- Difficulty reading or recognizing faces¹⁹
- Trouble adjusting from bright to dim lighting²⁷

Age-Related Macular Degeneration

Regular, dilated eye examinations are extremely important in helping to detect wet AMD.²⁷ The diagnosis of advanced AMD also generally requires tests known as fluorescein angiography (FA) or indocyanine green angiography, which use special intravenous dyes and a camera to evaluate the circulatory system of the retina and the condition of the back of the eye.^{19,28} Optical coherence tomography (OCT), a non-invasive technology used for producing cross-sectional images of the retina, is also used extensively in the diagnosis and management of AMD.^{35,36} OCT allows physicians to detect a variety of eye conditions earlier, which can dramatically improve the success of treatment outcomes for people.³⁷

Due to the rapid progression and severe, irreversible loss of central vision associated with wet AMD, regular screening, early diagnosis and treatment are important for the successful management of the disease.³⁸

Treatment

Dry AMD

While there is no FDA-approved treatment for dry AMD, the National Eye Institute's (NEI) Age-Related Eye Disease Study (AREDS) found that taking a high-dose formulation of antioxidants and zinc significantly reduces the risk of advanced AMD and associated vision loss.^{19,39}

Wet AMD

While there is no cure for wet AMD, timely and appropriate treatment may halt the progression of the condition and even improve vision in some cases.³¹

The current standard of care for wet AMD is anti-VEGF treatment. Abnormally high levels of a protein known as vascular endothelial growth factor (VEGF) occur in eyes with wet AMD and promote the growth and leakage of abnormal new blood vessels. The goal of FDA-approved anti-VEGF treatments is to block the effects of the growth factor in order to slow vision loss caused by the leaking blood vessels.⁴⁰

Age-Related Macular Degeneration

Other treatments for wet AMD include laser therapy and photodynamic therapy (PDT).²⁷

As with any prescription medication or procedure, treatments for AMD have safety risks. For more information, please review the full prescribing information for each product. Patients should also discuss treatment options with their physicians.

Fast Facts

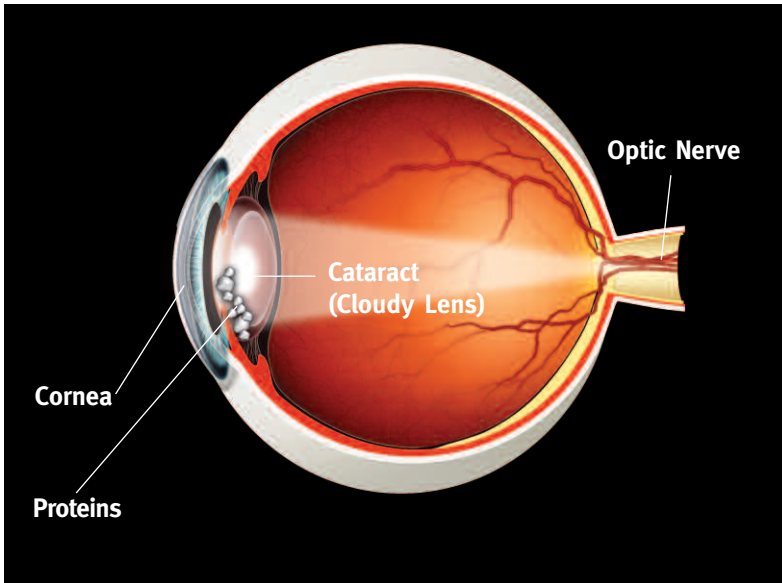
- Approximately 15 million people in the U.S. have AMD, and 1.7 million have the advanced form of the disease.²⁶
- AMD is a leading cause of blindness in Americans age 60 and older.¹⁹
- About 200,000 new cases of wet AMD are diagnosed each year in North America.⁴¹

Cataracts

What are Cataracts?

Cataracts are a clouding of the normally clear lens of the eye,⁴² preventing the retina from receiving a sharp image. The clouding, which can occur in either one or both eyes, happens when protein in the lens clumps together. Over time, the cataracts cover more of the lens, interfering with the ability to see clearly.²⁰ (See Figure 8)

FIGURE 8. CATARACTS MECHANISM OF DISEASE



Adapted from the U.S. National Institutes of Health, Medline Plus Medical Library.

Cataracts tend to expand slowly, so vision gradually worsens and becomes dull or blurred. However, some cases of cataracts, especially those in younger people and people with diabetes, may progress rapidly over a short time.⁴³ Cataracts may also be congenital or caused by trauma or disease.⁴⁴ Cataracts are not caused by overusing the eyes.⁴³

Cataracts

Risk Factors and Patient Demographics

- Most cataracts interfere with vision after age 60.^{20,45}
- Women are at a higher risk than men, and women who began menstruation late in life are at an even higher risk.⁴⁵
- African Americans and Hispanic Americans develop cataracts more often than Caucasians.⁴⁵
- People with type 1 or type 2 diabetes are at high risk for cataracts and are more likely to develop cataracts at a younger age.⁴⁵
- People with medical conditions requiring a high use of corticosteroids – such as rheumatoid arthritis, psoriasis, multiple sclerosis, systemic lupus erythematosus or Behcet’s disease – are also at particularly high risk.^{20,45}
- Exposure to even low-level UVB radiation from sunlight increases the risk for cataracts.⁴⁵
- Smokers are at an increased risk for developing cataracts.⁴⁵

Signs and Symptoms

FIGURE 9. VISION THROUGH THE EYES OF A PERSON WITH CATARACTS



Normal Vision



Vision Loss Due to Cataracts

Cataracts

The most common symptoms of cataracts are (See Figure 9):

- Cloudy or blurred vision²⁰
- Colors seem faded²⁰
- Poor night vision²⁰
- Glare becomes more noticeable; headlights, lamps, or sunlight may appear too bright²⁰

Diagnosis

Cataracts can be detected during a routine eye exam, which includes an eye chart test and the dilation of the eye to widen the pupil.²⁰

Treatment

Preliminary studies have suggested that the consumption of antioxidants may aid in the prevention of cataracts. Antioxidants, which can be obtained from certain foods and vitamin supplements, can neutralize the action of free radicals, thereby preventing damage to cells.⁴⁶

Currently, surgery is the only available treatment for vision loss caused by cataracts. There are two main types of cataract surgery: phacoemulsification and extracapsular cataract extraction.²⁰ In phacoemulsification, cataracts are removed and most of the back layer of the lens remains in place. Extracapsular cataract extraction is performed if cataracts advance to the point where phacoemulsification can't break up the clouded lens. During this procedure, the cataract is broken up into multiple small pieces and is removed. If a person has cataracts in both eyes, surgery will be performed on each eye separately, usually four to eight weeks apart.⁴⁷

As with any procedure, treatments for cataracts have safety risks. Patients should also discuss treatment options with their physicians.

Fast Facts

- An estimated 20.5 million Americans (17.2 percent) age 40 and older have been diagnosed with cataracts. The total number of Americans with cataracts is expected to rise to 30.1 million by 2020.⁴⁸
- Approximately one in every six people in the U.S. age 40 and older have developed cataracts; by age 80, more than half have been affected.^{20,45}

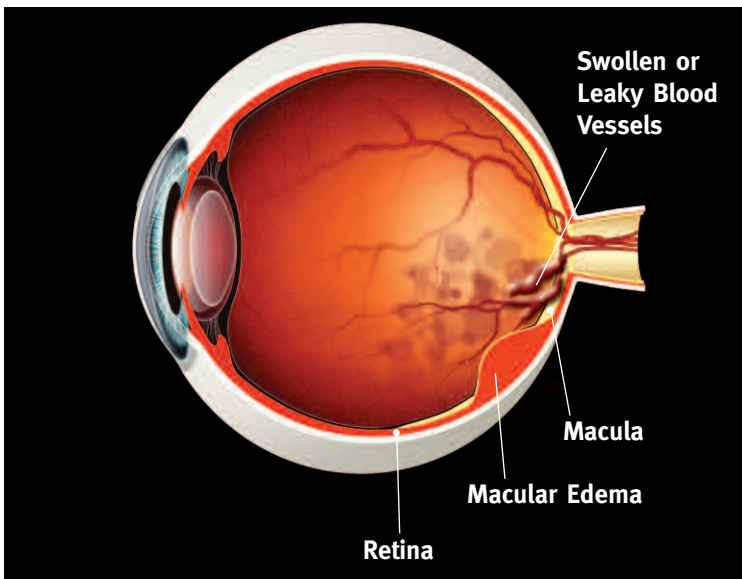
Diabetic Eye Disease

What is Diabetic Eye Disease?

Vision impairment is a common complication of both type 1 and type 2 diabetes. The major cause of blindness in people with diabetes is **diabetic retinopathy (DR)**, a term used for all of the possible abnormalities of the small blood vessels of the retina that are caused by diabetes, such as weakening of blood vessel walls or leakage from blood vessels.^{49,21} Diabetic retinopathy is the most common diabetic eye disease and usually affects both eyes;²¹ it can eventually lead to blindness.⁵⁰

One manifestation of DR is **diabetic macular edema (DME)**, or retinal swelling, which occurs when fluid leaks into the center of the macula, causing the macula to swell. Because the macula is responsible for detailed central vision, swelling caused by fluid from leaky blood vessels blurs vision.⁵¹ (See Figure 10) Although DME can occur at any stage of DR, it is more likely to occur as diabetes progresses.²¹

FIGURE 10. DIABETIC MACULAR EDEMA MECHANISM OF DISEASE



Adapted from Bethesda Retina, LLC, Eye Disease Library.

Diabetic Eye Disease

Risk Factors and Patient Demographics

- 20.8 million people in the U.S. have diabetes.⁵²
- 500,000 people in the U.S. have DME, with approximately 75,000 new cases developing each year in North America.⁵³
- The lifetime risk for a person with diabetes to develop DME is 10 percent.⁵⁴
- The risk for developing DME is closely associated with the length of time a person has lived with diabetes and the severity of DR.⁵⁵

Signs and Symptoms

FIGURE 11. VISION THROUGH THE EYES OF A PERSON WITH DIABETIC MACULAR EDEMA



Normal Vision



Vision Loss due to DME

With DME, there may be no noticeable changes in vision at first; however, over time, eyesight worsens and vision loss may occur.²¹ When symptoms of DME become apparent, they may include: (See Figure 11)

- Blurred vision²¹
- Floaters in the line of sight²¹

Diabetic Eye Disease

Diagnosis

DME is detected using an eye chart test, a dilated eye exam and a tonometry test, which uses an instrument to measure the pressure inside the eye.²¹

Because DME can develop without noticeable symptoms, a person with diabetes who has DME may still see clearly, but be at high risk for losing eyesight. Early detection via regular eye exams and timely treatment can prevent vision loss.²¹

The NEI recommends a comprehensive dilated eye exam at least once a year for all people with diabetes.⁵⁶ Eye care specialists also recommend proper diabetes management to prevent complications, including those of the eye.

Treatment

Laser therapy is a common treatment for DME. The goal of laser therapy is to seal leaking blood vessels by aiming a strong light beam onto the retina. Laser therapy is usually completed in one session; however, additional follow-up sessions may be needed to maintain a treatment effect.²¹

Anti-VEGF therapy is currently being investigated in clinical trials for the treatment of DME.

As with any prescription medication or procedure, treatments for DME have safety risks. For more information, please review the full prescribing information for each product. Patients should also discuss treatment options with their physicians.

Diabetic Eye Disease

Fast Facts

- Diabetes is the leading cause of new cases of blindness among adults ages 20 to 74.⁵⁷
- DME is a leading cause of vision loss among working-age Americans.⁵⁰
- Approximately 30 percent of adults with DME have had diabetes for 20 years or more, according to the Wisconsin epidemiology study.⁵⁸
- About half of the people with the most severe form of DR, proliferative retinopathy, also have DME. People who develop DME are at an increased risk for severe vision loss or even blindness.^{59,21}

Glaucoma

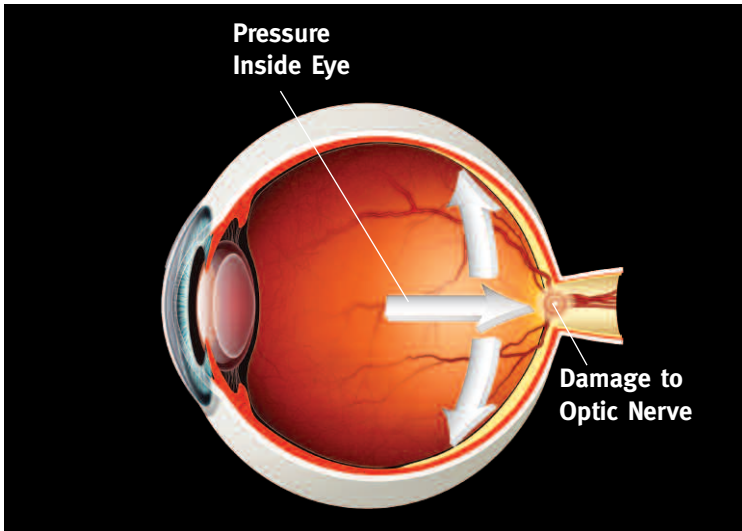
What is Glaucoma?

Glaucoma refers to a group of diseases that can damage the eye's optic nerve when normal fluid pressure inside the eye rises, resulting in vision loss and blindness.²²

The most common form of glaucoma, primary open-angle glaucoma, is associated with a slow increase in the fluid pressure inside the eye.⁶⁰ The aging eye's drainage system can gradually become clogged, which prevents intraocular fluid from draining properly.⁶¹ Left untreated, the pressure from the excess fluid may slowly and painlessly damage the optic nerve, which is responsible for transmitting images to the brain.⁶² (See Figure 12)

In closed-angle glaucoma – the less common form of glaucoma – the drainage canals in the eyes become blocked or covered suddenly because the angle between the iris and cornea is too narrow. When this occurs, pressure in the eye rises rapidly.⁶³

FIGURE 12. GLAUCOMA MECHANISM OF DISEASE



Adapted from the Mayo Foundation for Medical Education and Research.

Glaucoma

Risk Factors and Patient Demographics

- The risk of developing glaucoma increases slightly with each year of age.⁶⁰ Everyone over age 60 is at risk.²²
- Glaucoma is more common in African Americans than Caucasians. Risk among African Americans develops after age 40, which is earlier than other population groups.⁶⁰
- People with a family history of glaucoma are at increased risk.²²
- Diabetes, high blood pressure and heart disease may also increase the risk of developing glaucoma.⁶⁰

Signs and Symptoms

FIGURE 13. VISION THROUGH THE EYES OF A PERSON WITH GLAUCOMA



Normal Vision



Vision Loss due to Glaucoma

Open-angle glaucoma usually develops with no noticeable symptoms, even as irreversible damage to the optic nerve may be occurring.⁶⁴ As the disease progresses, peripheral vision gradually begins to fail, making it difficult to see objects to the side.⁶⁴ About half of all Americans with glaucoma do not know they have it and will likely suffer unnecessary vision loss.⁶⁵ (See Figure 13)

Glaucoma

Unlike people with open-angle glaucoma, people with closed-angle glaucoma may experience severe eye pain accompanied by nausea, blurred vision and red eye.⁶⁶

Diagnosis

Regular glaucoma check-ups include an eye chart test, a dilated eye exam, a visual field test to evaluate peripheral vision, a tonometry test to measure eye pressure, and an examination of the inside of the eye with an ophthalmoscope.^{22,67}

Treatment

There is no way to prevent open-angle glaucoma. However, early diagnosis and careful management are the keys to preventing vision loss associated with this condition.⁶⁸

The goal of glaucoma treatment is to reduce intraocular pressure and halt the progression of the disease to preserve eyesight. Prescription eye drops are a common first-line treatment. In some cases oral medications to lower intraocular pressure (such as carbonic anhydrase inhibitors),⁶⁹ laser therapy or surgery may be required to help halt the progression of the disease.⁶⁰

As with any prescription medication or procedure, treatments for glaucoma have safety risks. For more information, please review the full prescribing information for each product. Patients should also discuss treatment options with their physicians.

Fast Facts

- More than 3 million people in the U.S. have glaucoma.⁶⁴
- The number of individuals with open-angle glaucoma is predicted to increase by 50 percent to 3.3 million people by the year 2020.⁷⁰
- An estimated 9 to 12 percent of all cases of blindness in the U.S. are due to glaucoma.⁷¹

What is Retinal Vein Occlusion?

Retinal vein occlusion (RVO) occurs when the blood flow through a retinal vein becomes obstructed, causing swelling (edema) and hemorrhages in the retina. RVO most commonly is caused by either a clot (thrombus) in the retinal vein, or pressure from the retinal arteries on the vein as a result of diabetes, glaucoma, hardening of the arteries (atherosclerosis) or high blood pressure.^{72,23}

Without proper circulation, the normal draining of the retina needed to keep the eye healthy cannot occur. Consequently, low oxygen levels in the eye and increased pressure in the capillaries can lead to the growth of abnormal blood vessels or hemorrhaging, which can cause swelling or tissue damage and vision loss. This loss of vision is sometimes subtle in character, with intermittent episodes of blurred vision, or it may be sudden and dramatic.⁷³

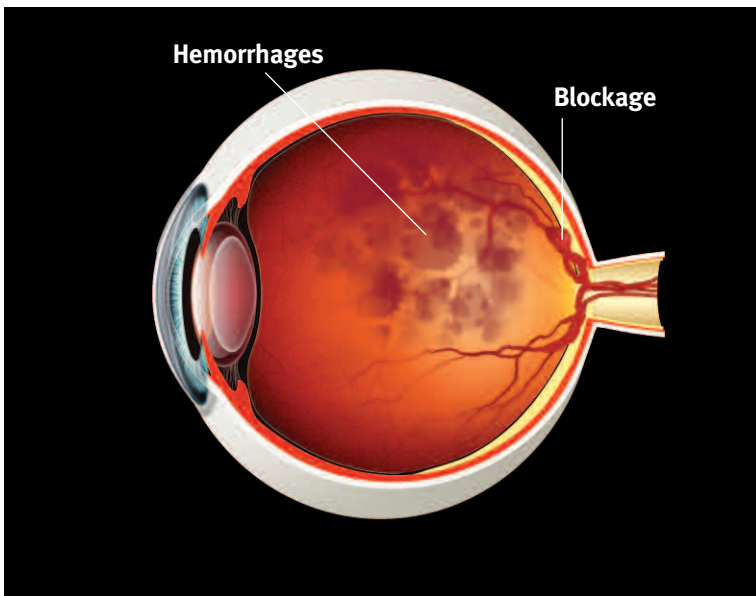
There are two main forms of RVO: **branch retinal vein occlusion (BRVO)** and **central retinal vein occlusion (CRVO)**.

Retinal Vein Occlusion

Branch Retinal Vein Occlusion

Branch retinal vein occlusion, which is three times more common than CRVO,⁷⁴ occurs when one of the smaller veins emptying into the main vein of the eye becomes blocked.⁷⁵ (See Figure 14) Usually, the blockage occurs at a site where an artery and a vein cross, and affects only a portion of the retina.⁷⁵ There are three types of complications associated with BRVO that can threaten vision: macular edema (swelling of the macula), macular ischemia (lack of blood supply), and neovascularization (growth of new abnormal blood vessels).⁷⁶

FIGURE 14. BRANCH RETINAL VEIN OCCLUSION MECHANISM OF DISEASE



Adapted from Bethesda Retina, LLC, Eye Disease Library.

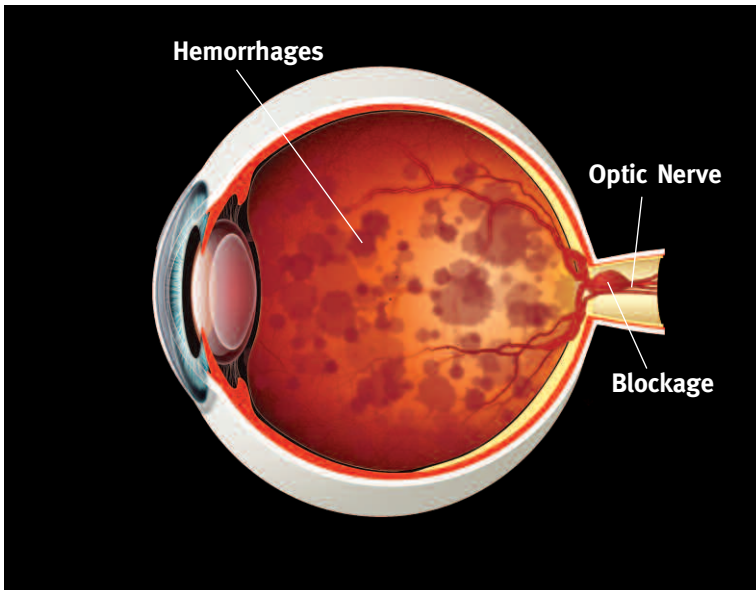
Retinal Vein Occlusion

Central Retinal Vein Occlusion

Central retinal vein occlusion, which is the less common form of RVO, occurs when the main vein of the eye (located at the optic nerve) becomes blocked. (See Figure 15) CRVO is generally categorized into two forms – non-ischemic or ischemic – based on the severity of the blockage.⁷⁶

The non-ischemic type accounts for 80 percent of CRVO cases, and is characterized by subtle, intermittent visual loss which is mild-to-moderate.⁷³ Non-ischemic CRVO may progress to the ischemic type, the less common form of the condition which accounts for about 20 percent of CRVO cases.⁷⁷ Ischemic CRVO is characterized by acute vision loss that is severe in nature.⁷³

FIGURE 15. CENTRAL RETINAL VEIN OCCLUSION MECHANISM OF DISEASE



Adapted from Bethesda Retina, LLC, Eye Disease Library.

Retinal Vein Occlusion

Risk Factors and Patient Demographics

It is important to recognize the symptoms of RVO and diagnose it early because it can be a warning sign that other systemic diseases may be present in some people, which may pose further risks to overall health. Hypertension, hyperlipidemia, diabetes and a history of glaucoma are all known risk factors of RVO.^{78,79}

- People with RVO are often elderly, with a history of diseases such as diabetes and hypertension.²³ However, younger, working-age people may also develop RVO.
- People with high blood pressure, vascular disease and diabetes are at an increased risk for developing BRVO and CRVO.⁸⁰
- Certain risk factors associated with hardening of the arteries (atherosclerosis), such as elevated levels of serum lipids (e.g., cholesterol and triglycerides), and smoking are also thought to increase the risk of RVO.^{72,73}
- Other medical conditions, including autoimmune diseases, leukemia, anemia and vasculitis have also been associated with an increased risk for developing BRVO.⁷⁶
- RVO occurs more often in men than in women.⁸¹
- Women of reproductive age taking oral contraceptives have been shown to be at greater risk for RVO.⁸²

Retinal Vein Occlusion

Signs and Symptoms

FIGURE 16. VISION THROUGH THE EYES OF A PERSON WITH RVO



Normal Vision



Vision Loss due to RVO

Sudden blurring or vision loss in all or part of one eye is most common with RVO.⁸³ Less frequently, people may experience a temporary loss of central vision lasting a few seconds to minutes. Thought to be caused by an incomplete vein blockage that becomes a total obstruction over time, these symptoms may recur over several weeks and be followed by a steady decline in vision.⁸³ (See Figure 16) Because of its abrupt nature⁸⁴ and onset in a younger population, RVO can have a significant impact on people with occupational and family obligations that can be disrupted by impaired vision.

Retinal Vein Occlusion

Diagnosis

An ophthalmologist diagnoses RVO by examining the inside of the eye, specifically the retina and optic nerve, with an ophthalmoscope. Fluorescein angiography (FA) and optical coherence tomography (OCT) may also be used to assess macular edema and the presence of complications associated with RVO and to monitor treatment effects.⁸⁵

Branch retinal vein occlusion is detectable when an area of the retina exhibits localized tissue swelling or macular edema. The longer the swelling persists the more significant the visual loss will be.⁷³

Central retinal vein occlusion is detectable when all of the major retinal veins appear swollen, with edema and retinal hemorrhages present throughout the entire retina.⁸⁶

Treatment

Retinal vein occlusion cannot be anticipated and therefore cannot be prevented in most cases. Experts suggest that measures to prevent conditions such as coronary artery disease, including a low-fat diet, exercise and weight loss, may help prevent the onset of RVO.²³

Similar to the treatment of diabetic eye disease, treatment for RVO requires a holistic view of the person at risk, who may also have a systemic disease that will need to be considered. As such, an internist may also be consulted and collaborate with the retina specialist when determining a treatment plan.^{78,79}

There is no known cure for RVO, though in some cases laser therapy may be used.⁸⁷ Non-ischemic CRVO resolves completely without any complications in about 10 percent of all cases.⁷³

Anti-VEGF therapies and steroids are currently being investigated in clinical trials for the treatment of RVO.

As with any prescription medication or procedure, treatments for RVO have safety risks. For more information, please review the full prescribing information for each product. Patients should also discuss treatment options with their physicians.

Retinal Vein Occlusion

Fast Facts

- RVO is the second most common retinal vascular disease after diabetic retinopathy and is a common cause of blindness in older people.⁸⁸
- According to population-based studies, the prevalence (number of cases of a disease that are present in a particular population at a given time) of BRVO is 0.6 percent to 1.6 percent,⁸⁹ and the prevalence of CRVO is 0.1 percent to 0.4 percent in adults 40 years of age and older.⁹⁰
- The 15-year cumulative incidences (the frequency by which a disease appears in a particular population) of BRVO and CRVO are 1.8 and 0.5 percent, respectively.⁹¹
- Of the estimated new cases per year, there will be three times as many cases of BRVO than CRVO.⁷⁴

Eye Disease Experts

The following experts have agreed to be contacted by reporters to discuss age-related eye diseases:

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Dr. David Boyer is a renowned retina specialist, surgeon and educator. He is also a clinical professor of ophthalmology at the University of Southern California, Keck School of Medicine.

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Bruce P. Rosenthal, O.D.

Lighthouse International (New York, NY)

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Vitreous-Retina-Macula Consultants of New York (New York, NY)

(212) 861-9797

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Media Resources

Government Organizations and Professional Groups

American Academy of Ophthalmology

<http://www.aaopt.org/>

P.O. Box 7424

San Francisco, CA 94120-7424

Phone: (415) 561-8500

American Optometric Association

<http://www.aoa.org/>

243 N Lindbergh Blvd # 1

St Louis, MO 63141

Phone: (314) 991-4100

American Society of Cataract and Refractive Surgery

<http://www.ascrs.org/>

4000 Legato Rd., Ste. 700

Fairfax, VA 22033

Phone: (703) 591-2220

American Society of Retina Specialists

<http://www.asrs.org/>

American Society of Retina Specialists

PMB #A

2485 Notre Dame Blvd., Suite 370

Chico, CA 95928

Phone: (530) 566-9181

ClinicalTrials.gov, a service of the National Institutes of Health

<http://clinicaltrials.gov/>

National Eye Institute

<http://www.nei.nih.gov/>

31 Center Drive MSC 2510

Bethesda, MD 20892-2510

Phone: (301) 496-5248

Opticians Association of America

<http://www.oaa.org/>

441 Carlisle Drive

Herndon, VA 20170

Phone: (901) 388-2423

Media Resources

Patient Advocacy Groups

AMD Alliance International

<http://www.amdalliance.org/>
AMD Alliance International
1929 Bayview Avenue
Toronto, Ontario M4G 3E8
Phone: (877) AMD-7171

American Diabetes Association

<http://www.diabetes.org>
American Diabetes Association
1701 North Beauregard Street
Alexandria, VA 22311
Phone: (800) 342-2383

Foundation Fighting Blindness

<http://www.blindness.org/>
Foundation Fighting Blindness
11435 Cronhill Drive
Owings Mills, MD 21117-2220
Phone: (800) 683-5555

Glaucoma Research Foundation

<http://www.glaucoma.org/>
Glaucoma Research Foundation
251 Post Street, Suite 600
San Francisco, CA 94108
Phone: (800) 826-6693

Juvenile Diabetes Research Foundation

<http://www.jdrf.org/>
Juvenile Diabetes Research Foundation
120 Wall Street
New York, NY 10005-4001
Phone: (800) 533-CURE (2873)

Lighthouse for the Blind

<http://www.lighthouse.org/>
The Sol and Lillian Goldman Building
111 East 59th Street
New York, NY 10022-1202
Phone: (212) 821-9200

Macular Degeneration Partnership

<http://www.AMD.org/>
MD Partnership
6222 Wilshire Blvd., Suite 260
Los Angeles, CA 90048
Phone: (310) 623-4466

Prevent Blindness America

<http://www.preventblindness.org/>
Prevent Blindness America
211 West Wacker Drive, Suite 1700
Chicago, IL 60606
Phone: (800) 331-2020

Following is a list of all images included in this handbook:

Overview of the Eye and Blindness

Figure 1. Anatomy of the Eye (Page 2)

Age-Related Macular Degeneration

Figure 2. Dry AMD Mechanism of Disease (Page 6)

Figure 3. Wet AMD Mechanism of Disease (Page 7)

Figure 4. Vision Through the Eyes of a Person with Wet AMD (Page 9)

Figure 5. Snellen Chart (Page 10)

Figure 6. Amsler Grid (Page 10)

Figure 7. Early Treatment of Diabetic Retinopathy Study Chart (Page 10)

Cataracts

Figure 8. Cataracts Mechanism of Disease (Page 13)

Figure 9. Vision Through the Eyes of a Person with Cataracts (Page 14)

Diabetic Eye Disease

Figure 10. Diabetic Macular Edema Mechanism of Disease (Page 17)

Figure 11. Vision Through the Eyes of a Person with Diabetic Macular Edema (Page 18)

Glaucoma

Figure 12. Glaucoma Mechanism of Disease (Page 21)

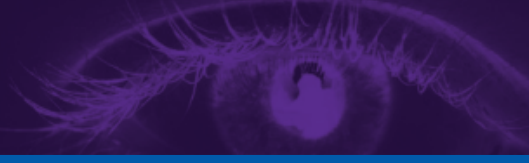
Figure 13. Vision Through the Eyes of a Person with Glaucoma (Page 22)

Retinal Vein Occlusion

Figure 14. Branch Retinal Vein Occlusion Mechanism of Disease (Page 25)

Figure 15. Central Retinal Vein Occlusion Mechanism of Disease (Page 26)

Figure 16. Vision Through the Eyes of a Person with Retinal Vein Occlusion (Page 28)



Age-related macular degeneration (AMD, ARMD) (MAK-yu-lur): A condition that involves the deterioration of the macula, resulting in loss of sharp central vision. Two general types: “dry,” which is more common, and “wet,” an advanced form of the disease in which abnormal new blood vessels grow under the retina and leak fluid and blood (neovascularization), further disturbing macular function. Age-related macular degeneration is a leading cause of vision loss for Americans age 60 and older.^{19,44}

Amsler grid (AM-slur): Grid (black lines on white background or white lines on black background) used for detecting central visual field distortions or defects, such as in AMD.⁴⁴

Angiogenesis: The process of cell differentiation and migration that forms new blood vessels. Angiogenesis begins very early in embryonic development to ensure an adequate supply of oxygen and nutrients to the growing organs. Angiogenesis is normally regulated throughout development and adult life.⁹²

Anti-vascular endothelial growth factor (VEGF) treatment: A drug that inhibits the growth of new blood vessels.³⁹

Aqueous (AY-kwee-us), aqueous humor: Clear, watery fluid that fills the space between the back surface of the cornea and the front surface of the vitreous, bathing the lens. Nourishes the cornea, iris, and lens and maintains intraocular pressure.⁴⁴

Branch retinal vein occlusion (BRVO): A blockage of the smaller branch of vessels attached to the main retinal vein, causing bleeding in parts of the retina.⁷³

Cataract: Opacity or cloudiness of the crystalline lens, which may prevent a clear image from forming on the retina. May be congenital or caused by trauma, disease, or age.⁴⁴

Cataract extraction: Removal of a cloudy lens from the eye. An extracapsular cataract extraction leaves the rear lens capsule intact; with an intracapsular extraction there is complete removal of the lens with its capsule.⁴⁴

Glossary

Central retinal artery: First branch of the ophthalmic artery; supplies nutrition to the inner two-thirds of the retina.⁴⁴

Central retinal vein: Blood vessel that collects retinal vein blood drainage; exits the eye through the optic nerve.⁴⁴

Central retinal vein occlusion (CRVO): A blockage of the central retinal vein by a clot.⁸⁶

Central vision: An eye's most important vision; used for reading and discriminating fine detail and color. Results from stimulation of the fovea and the macular area.⁴⁴

Choroid (KOR-oyd): Vascular (major blood vessel) layer of the eye between the retina and the sclera. Provides nourishment to outer layers of the retina.⁴⁴

Cone: Light-sensitive retinal receptor cell that provides sharp visual acuity and color discrimination.⁴⁴

Cornea (KOR-nee-uh): Transparent front part of the eye that covers the iris, pupil, and anterior chamber and provides most of an eye's optical power.⁴⁴

Crystalline lens: The eye's natural lens. Transparent, biconvex intraocular tissue that helps bring rays of light to a focus on the retina.⁴⁴

Diabetic macular edema (DME): Swelling of the retina in people with diabetes mellitus due to leaking of fluid from blood vessels within the macula.⁹³

Diabetic retinopathy (ret-in-AHP-uh-thee): A term used for all of the possible abnormalities of the small blood vessels of the retina that are caused by diabetes, such as weakening of blood vessel walls, leakage from blood vessels, or macula edema.²¹

Drusen (DRU-zin): Tiny, white or yellow deposits on Bruch's membrane (of the retinal pigment epithelium). Common after age 60; sometimes an early sign of AMD.⁴⁴

Early Treatment of Diabetic Retinopathy Study chart (ETDRS): An eye test which aids in evaluating changes in vision.⁹⁴

Glossary

Extraocular muscles (eks-truh-AHK-yu-lur): Six muscles that move the eyeball (lateral rectus, medial rectus, superior oblique, inferior oblique, superior rectus, inferior rectus).⁴⁴

Fluorescein angiography (FA) (FLOR-uh-seen an-jee-AH-gruh-fee): Technique used for visualizing and recording location and size of blood vessels and any eye problems affecting them; during an FA, fluorescein dye is injected into an arm vein, then rapid, sequential photographs are taken of the eye as the dye circulates.⁴⁴

Fovea (FOH-vee-uh): Central pit in the macula that produces sharpest vision. Contains a high concentration of cones and no retinal blood vessels.⁴⁴

Glaucoma (glaw-KOH-muh): Disease characterized by increased intraocular pressure resulting in damage to the optic nerve and retinal nerve fibers. A common cause of preventable vision loss.⁴⁴

Iris: The circular, colored part of the eye. Its opening forms the pupil. The iris helps regulate the amount of light that enters the eye.⁹⁵

Legal blindness: Best-corrected visual acuity of 20/200 or less, or reduction in visual field to 20 feet or less, in the better seeing eye.⁴⁴

Lens, crystalline lens: The eye's natural lens. Transparent, biconvex intraocular tissue that helps bring rays of light to a focus on the retina.⁴⁴

Low vision: Low vision refers to visual impairment, not corrected by standard glasses, contact lenses, medicine, or surgery, that interferes with the ability to perform everyday activities. Most people develop low vision because of eye diseases such as cataract, glaucoma, DME or AMD. Low vision primarily affects people over age 65.⁹⁶

Macula: Small central area of the retina surrounding the fovea; area of acute central vision.⁴⁴

Neovascularization (nee-oh-VAS-kyu-lur-ih-ZAY-shun): Abnormal formation of new blood vessels, usually in or under the retina or on the iris surface. May develop in DME, RVO, or AMD.⁴⁴

Glossary

Ophthalmologist (ahp-thal-MAH-loh-jist): Physician (M.D.) specializing in diagnosis and treatment of refractive, medical and surgical problems related to eye diseases and disorders.⁴⁴

Ophthalmoscope (ahp-THAL-muh-skohp): Illuminated instrument for visualizing the interior of the eye (especially the fundus).⁹⁷

Optical coherence tomography (OCT): A non-invasive imaging technique, similar to ultrasound, which has a broad range of applications for the diagnosis and management of a variety of eye conditions.⁹⁸

Optician (ahp-TISH-un): Professional who makes and adjusts optical aids, e.g., eyeglass lenses, from refraction prescriptions supplied by an ophthalmologist or optometrist.⁴⁴

Optic nerve: Largest sensory nerve of the eye; carries impulses for sight from the retina to the brain.⁴⁴

Optometrist (ahp-TAHM-uh-trist): Doctor of optometry (O.D.) specializing in vision problems, treating vision conditions with eye glasses, contact lenses, low vision aids and vision therapy, and prescribing medications for certain eye diseases.⁴⁴

Pupil: Variable-sized black circular opening in the center of the iris that regulates the amount of light that enters the eye.⁴⁴

Retina (RET-ih-nuh): Light sensitive nerve tissue in the eye that converts images from the eye's optical system into electrical impulses that are sent along the optic nerve to the brain. Forms a thin membranous lining of the rear two-thirds of the eye ball.⁴⁴

Retinal detachment: Separation of the retina from the underlying pigment epithelium. Disrupts visual cell structure and thus markedly disturbs vision. Almost always caused by a retinal tear; often requires immediate surgical repair.⁴⁴

Glossary

Retina specialist: Retina specialists are eye doctors, typically (but not exclusively) ophthalmologists, who have completed additional subspecialty fellowship training in the diagnosis and pharmaceutical, surgical, and laser treatment of retinal diseases. They frequently address the most complicated and challenging retinal diseases.¹⁴

Retinal vein occlusion (RVO): Retinal vein occlusion is a blockage in the blood supply from the retina – the light-sensitive tissue in the back of the eye.²³ There are two types – branch retinal vein occlusion and central retinal vein occlusion.

Retinoscope (RET-in-oh-skohp): Device for measuring the interior of the eye. Light is projected into the eye, and the movements of the light reflection from the eye are neutralized (eliminated) with lenses.⁹⁹

Rod. Light-sensitive, specialized retinal receptor cell that works at low light levels (night vision). A normal retina contains 150 million rods.⁴⁴

Sclera (SKLEH-ruh): Opaque, fibrous, protective outer layer of the eye (“white of the eye”) that is directly continuous with the cornea in the front of the eye and with the sheath covering the optic nerve behind the eye.⁴⁴

Snellen chart: Test chart used for assessing visual acuity. Contains rows of letters, numbers, or symbols in standardized graded sizes, with a designated distance at which each row should be legible to a normal eye. Usually tested at 20 ft.⁴⁴

Tonometry (tuh-NAH-mih-tree): Measurement of intraocular pressure.¹⁰⁰

20/20: Normal visual acuity; upper number is the standard distance (20 feet) between an eye being tested and the eye chart; lower number indicates that a tested eye can see the same small standard-sized letters or symbols as a normal eye at 20 feet.⁴⁴

Visual acuity: Assessment of the eye’s ability to distinguish object details and shape, using the smallest identifiable object that can be seen at a specified distance (usually 20 ft. or 16 in.).⁴⁴

Glossary

Vitreous (VIT-ree-us), **vitreous humor**. Transparent, colorless gelatinous mass that fills the rear two-thirds of the eyeball, between the lens and the retina.⁴⁴

Vitreous detachment: Separation of vitreous gel from retinal surface. Usually innocuous, but can cause retinal tears, which may lead to retinal detachment. Frequently occurs with aging as the vitreous liquefies, or in some disease states such as diabetes and high myopia.⁴⁴

Vascular endothelial growth factor (VEGF): A protein involved in causing new blood vessel formation. In the case of AMD these new blood vessels are unstable and tend to leak fluid and blood under the retina, causing loss of central vision.³⁹

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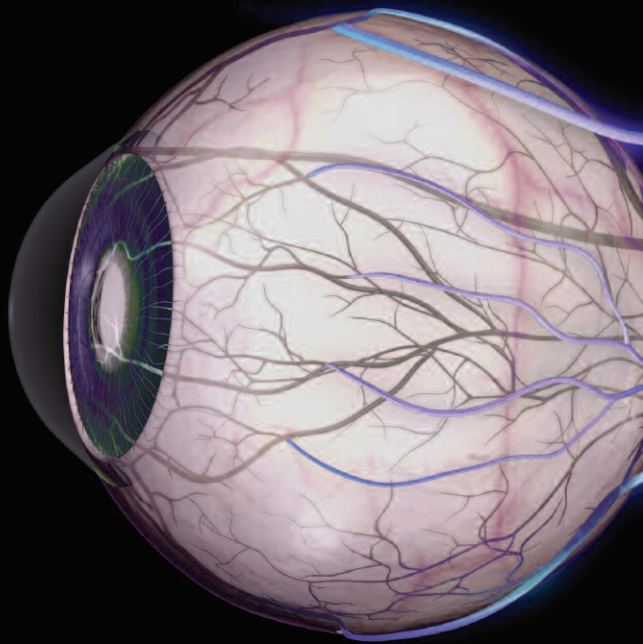
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