

GLAUCOMA



Symptoms

Risk

Prevention

Treatment

Research

Hope



Research to Prevent Blindness
645 Madison Avenue
New York, N.Y. 10022
www.rpbusa.org

WHAT IS GLAUCOMA?

Glaucoma is a general term for a family of eye diseases, which, in most cases, lead to increased pressure within the eye and, as a result, damage the optic nerve. The most common form, *primary open-angle glaucoma*, initially causes painless loss of peripheral vision and may lead to blindness if



untreated over many years. Symptoms of a less common form, *acute angle-closure glaucoma*, may develop suddenly, accompanied by intense pain, and blindness may occur within a day or two if left untreated.

2

In general, glaucoma is more common in African-Americans and Hispanics, and the risk of developing glaucoma increases with age. It is the second leading cause of blindness in all Americans and is generally accepted as an inherited disorder.

While glaucoma cannot be prevented, *regular, complete eye examinations by an eye specialist can lead to early detection—and treatment often prevents loss of sight.*

WHAT CAUSES GLAUCOMA?

The underlying cause (or causes) of glaucoma remains unknown, although it is often accompanied by an increase of fluid pressure within the eye (called *intraocular pressure*).

The fluid within the eye, called the *aqueous humor*, nourishes the eye's lens and cornea. In healthy eyes, a pressure balance is maintained between the fluid that is produced by the *ciliary body* and the fluid that drains through specialized cells and tissue, called the *trabecular meshwork*. If an injury or other factors affect this drainage area, disrupting the inflow/outflow balance, pressure can rise in the eye, which may eventually damage the optic nerve (the bundled nerve cells that transmit signals from the eye to the brain).

Not everyone with high intraocular pressure develops the disease and about one in five cases occurs in people with eye pressure that is within the normal range. In every case, however, the result is optic nerve damage. Research is steadily uncovering factors that contribute to optic nerve damage.

3



This photo represents the way a person's vision can be affected by glaucoma.

TYPES OF GLAUCOMA

Primary open-angle glaucoma, the most common form of the disease, develops over time as the drainage angle tissue becomes clogged, causing the aqueous humor to drain

too slowly and a gradual rise in intraocular pressure. The risk of developing *open-angle glaucoma* increases with age.

Glaucoma in people with normal intraocular pressure is called **normal tension, normal pressure** or **low-tension glaucoma**. It is not yet understood why glaucoma develops in people with normal intraocular pressure.

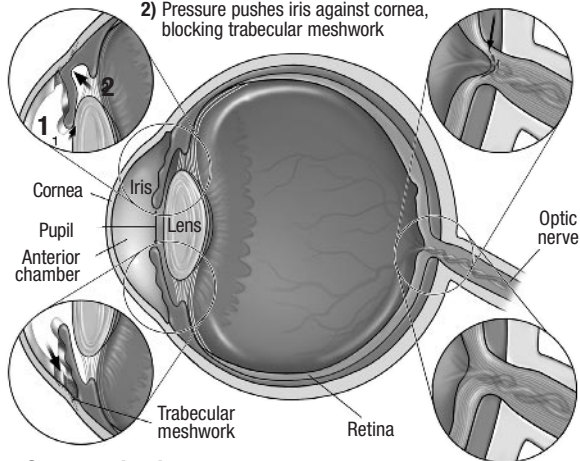
In **angle-closure glaucoma**, the outlet between the iris and cornea is not as wide and open as it should be and ultimately closes due to interference from the lens, which tends to grow larger as we age. The resulting reduced flow of aqueous humor builds up pressure behind the iris and further reduces drainage through the trabecular meshwork, damaging the optic nerve.

4

Angle-closure glaucoma

- 1) Iris and lens stick together
- 2) Pressure pushes iris against cornea, blocking trabecular meshwork

Damaged optic nerve



Open-angle glaucoma

Drainage canals become obstructed

Healthy optic nerve

If enough pressure builds behind the iris to force it against the trabecular meshwork, the fluid flow is suddenly blocked, causing a rapid and painful rise in eye pressure and an **acute angle-closure glaucoma** attack. Acute-angle

attacks can be triggered by darkened environments or stress, both of which cause the eye's pupil to dilate, creating maximum contact between the lens and the iris. Some medication can also cause acute angle-closure attacks. *Acute angle-closure glaucoma requires immediate medical attention. If not corrected quickly, the elevated pressure can lead to permanent damage of the optic nerve.*

Secondary glaucomas can appear as a complication of eye surgery or advanced cataracts, or can result from eye injuries, certain eye tumors, or eye inflammation. **Pigmentary glaucoma** occurs when pigment from the iris flakes off and clogs the trabecular meshwork. **Neovascular glaucoma** is linked to diabetes. Other, less common, types of glaucoma include *juvenile open-angle glaucoma*, *congenital glaucoma*, *developmental glaucomas* (Rieger syndrome and aniridia) and *pseudoexfoliation glaucoma*. Long-term use of certain steroid drugs can trigger glaucoma in genetically predisposed individuals. Contact your eye doctor or Research to Prevent Blindness for further information on these forms of the disease.

SYMPTOMS

Open-angle glaucoma

The early stages of *open-angle glaucoma* are painless and vision is not affected. As pressure continues to build within the eye over time, and the cells and nerve fibers that create the optic nerve die, "blind spots" form in the outer sides of the field of vision. This loss of side vision may also go unnoticed unless detected by a detailed visual field examination. As the disease progresses, the field of vision narrows.

Acute angle-closure glaucoma

Severe pain, reddened eyes, blurred vision, haloes around lights, headaches, nausea and vomiting can accompany *acute angle-closure glaucoma*. A minor attack may involve painless blurred vision and haloes around lights.

Chronic angle-closure glaucoma

Symptoms of *chronic angle-closure glaucoma* may develop in a manner that is a combination of the two forms described above. Symptoms may often be painless like open-angle glaucoma, but usually patients have brief episodes of blurry vision and discomfort that accompany intermittent attacks of angle closure. Eventually, when the entire angle is closed from repeated brief attacks, high pressure may cause constant pain and visual blurring. As in any form of glaucoma, long-term pressure elevation can ultimately lead to blindness.

CAN GLAUCOMA BE PREVENTED?

Too little is known about the initial causes of glaucoma to prevent its onset and, currently, treatments are not available to reverse optic



nerve damage. *However, in most cases where glaucoma is detected in the early stages, loss of vision can be prevented with current therapies and committed patient adherence to a treatment plan.*

The more optic nerve damage that exists at the time of diagnosis, the more likely it is that some or all sight will be lost. *Understanding your level of risk and having your eyes examined according to a recommended schedule are the most important preventive steps you can take in guarding against loss of vision.*

WHO'S AT RISK?

More than two million Americans have been diagnosed with glaucoma — but as many as half the people with glaucoma do not know they are affected because even with subtle early damage to the optic nerve and elevation of eye pressure, they are often totally free of symptoms. This is the reason the most common form of glaucoma is often referred to as a silent disease or as the "sneak-thief" of sight.

Certain risk factors increase a person's chances of developing glaucoma:

- ◆ **Elevated intraocular pressure**
- ◆ **African-American over age 40**
- ◆ **Anyone over age 60**
- ◆ **Family history of glaucoma**
- ◆ **Nearsightedness**
- ◆ **Past injury to the eye**
- ◆ **Diabetes**
- ◆ **High blood pressure**
- ◆ **Long exposure to steroid/cortisone products**

African-Americans have a three to four times greater risk of developing *open-angle glaucoma* than whites and are six times more likely to go blind from it. The disease generally develops at an earlier age in blacks, about age 40, and progresses more rapidly.

Family history, Japanese ancestry, and a history of systemic heart disease (such as irregular heart rhythm) are risk factors for *normal tension glaucoma*.

Angle-closure glaucoma runs in families, and often occurs in patients who are far-sighted. Far-sighted people have slightly smaller eyes, which predispose the angle to "crowding" by the lens of the eye. Angle closure is five times more common in people of Asian descent than those of African or European descent.

8

An additional risk factor for developing *acute-angle closure glaucoma* can be the use of drugs that cause pupil dilation such as anti-depressants, cold medications, antihistamines, and some anti-nausea medications, among others.

RECOMMENDED SCHEDULE FOR GLAUCOMA EXAMINATIONS

- ◆ Everyone with a family history of glaucoma and *all* African-Americans should be examined every three to five years between ages 20 and 39. Others in this age group should have an examination at least once during this time.
- ◆ Between ages 40 and 64, people should be tested every two to four years.
- ◆ After age 64, examinations are recommended every one to two years.

- ◆ People with diabetes should be screened for glaucoma and other eye conditions every year.

DIAGNOSIS AND TREATMENT

While vision loss due to glaucoma cannot be reversed, various treatments are available to prevent further loss of vision. Early diagnosis, routine exams and keeping intraocular pressure under control are key factors in retaining useful sight. *As with any chronic disease, regular use of medication is critical.*

DETECTING GLAUCOMA

The most reliable way to detect glaucoma is a comprehensive eye examination, including viewing the optic nerve. Eye doctors use four types of painless measurements to aid them in diagnosing the disease.

- ◆ **Tonometry** is a quick test with an instrument that records intraocular pressure.
- ◆ **Gonioscopy** is an inspection of the eye's drainage angle to detect narrowing.
- ◆ **Ophthalmoscopy** enables the examiner to observe the optic nerve.
- ◆ If damage is suspected, the eye doctor should use **perimetry** to test the patient's visual field. This test is particularly important because it can detect early loss of peripheral vision, which may indicate glaucoma.

TREATMENTS

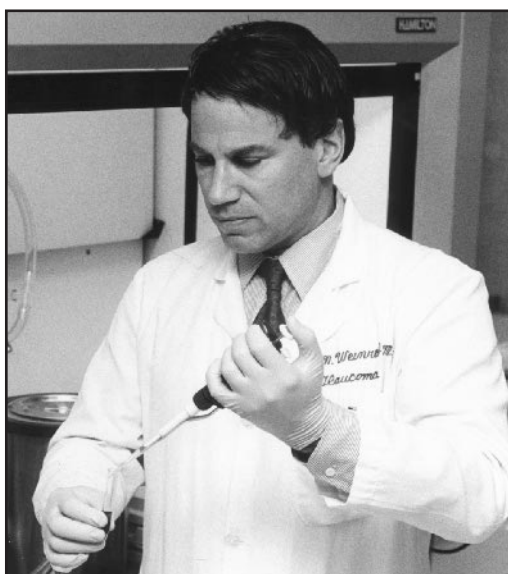
Some patients use eye drops, pills or both to lower intraocular pressure by slowing the secretion of the aqueous fluid or improving its flow out of the eye. Operative and laser surgeries to improve fluid drainage are usually

reserved for patients whose glaucoma continues to progress in spite of medications, but *angle-closure glaucoma* is initially treated by surgery to unblock the drainage canals.

In conventional surgery, called *trabeculectomy*, a new drainage path in the eye is created under the eyelid. In laser surgery, called *trabeculoplasty*, a narrow beam of light is aimed at the trabecular meshwork. The effects of laser surgery may last only two or three years, but the procedure can be repeated in some patients. After laser and/or operative procedures, people may still have to take eye drops to further lower eye pressure.

RESEARCH- HOPE FOR THE FUTURE

10 Promising new approaches to treat glaucoma and the optic nerve complications associated with it are emerging from research projects worldwide, many of them funded by Research to Prevent Blindness (RPB). Ways to protect and



even regenerate neurons are being explored. Many of these RPB-sponsored investigations focus on the underlying genetic and molecular causes of glaucoma as well as on improving the effectiveness of available current therapies.

In one promising area of research, dying neurons of the optic nerve show clear signs of *programmed cell death* (a way for the body to rid itself of cells it no longer needs). Recent findings raise the possibility that one or more steps in programmed cell death can be blocked or slowed.

In another area, emerging evidence suggests that glaucoma, at least in some people, may be an *autoimmune* disease — one in which the body's protective immune system mistakenly attacks its own cells. Autoimmune diseases only occur in people susceptible to them, and research into that susceptibility mechanism may increase knowledge about the cause(s), prevention and treatment of glaucoma.

Gene therapies to improve the efficiency of the trabecular meshwork and to counteract programmed cell death and other mechanisms that cause optic neurons to die are all in development. DNA-based testing to identify people at risk before any vision deterioration occurs is also being investigated. This is especially significant because recently completed studies have shown that eye drops used to treat elevated intraocular pressure can be effective in delaying the onset of glaucoma in patients at higher risk for development of the disease.

*Mosaic detail on the cover is from: Kristin Jones and Andrew Ginzel
Oculus, 1998. Stone mosaic wall murals and glass floor mosaic,
World Trade Center/Chambers Street/Park Place subway stations.*

*Commissioned by Metropolitan Transportation Authority
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Research to Prevent Blindness (RPB) has led the way for over forty years to dramatic advances in eye care, which have saved the sight or restored useful vision to millions throughout the world. But more has to be done, and RPB is counting on you.

Your donation can help us continue our extensive research program. Every gift is important.

To donate or for further information on RPB, glaucoma, or any other eye disease, visit www.rpbusa.org.

You can also reach us at:

Research to Prevent Blindness
645 Madison Avenue
New York, NY ■ 10022-1010

Tel.: (212) 752-4333 or
1-800-621-0026

Fax: 212-688-6231

Web site: www.rpbusa.org
E-mail: inforequest@rpbusa.org

