

## Alpha Agonists for the Treatment of Glaucoma

While there is no cure for glaucoma, it can be controlled with proper management.

Elevated **intraocular pressure (IOP)** can damage the optic nerve, which may lead to vision loss. Treatment for glaucoma focuses on lowering the IOP to a level that is less likely to cause further optic nerve damage. This is known as the “target pressure.” The target pressure differs from individual to individual. Your target pressure may change during your course of treatment.

If you have glaucoma, your ophthalmologist (Eye M.D.) may prescribe medication to lower your eye pressure. There are many more choices for topical treatment with eyedrops today than there were only a few years ago. Your ophthalmologist has chosen an **alpha agonist** medication to treat your glaucoma.

### How Do Alpha Agonists Work?

Alpha agonist medications are reliable for lowering the intraocular pressure. They work by decreasing the production of the fluid that the eye continually makes, called the aqueous humor.

### What Are the Alpha Agonists?

There are three alpha agonist drugs:

- apraclonidine (Iopidine);
- brimonidine (Alphagan, Alphagan P); and
- dipivefrin (Propine).

A generic version of Alphagan is available.

### Possible Side Effects of Alpha Agonists

All medications, including eyedrops, can have side effects. Some people taking alpha agonist eyedrops may experience

- dry mouth;
- ocular allergy with a red eye or red eyelids;
- tiredness or fatigue;
- low or high blood pressure and possible slowing of heart rate (less than with beta blockers);
- blurred vision;
- sensitivity of the eyes to bright light; and
- headache.

For glaucoma medications to work, you must take them regularly and as prescribed by your doctor.

### Medication Tips

With each new medication that your ophthalmologist prescribes, make sure you understand the

following:

- the name of the medication;
- how to take it;
- how often to take it;
- how to store it;
- if you can take it with your other medications (make sure all of your doctors know about all the different medications you take, including nonprescription medications);
- what the possible side effects may be;
- what you should do if you experience side effects; and
- what you should do if you miss a dose.

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## Intraocular Pressure

Elevated intraocular pressure (high pressure within the eye) is the number one risk factor for glaucoma. However, elevated intraocular pressure (IOP) does not always cause glaucoma.

The average eye pressure in adults ranges between 10 mm Hg and 21 mm Hg (“mm Hg” stands for “millimeters of mercury”). There can be a significant difference in your IOP throughout the course of a day. This variation is known as diurnal fluctuation. We know that many patients with IOP in the 20s do not develop glaucoma. Up to 50% of patients diagnosed with glaucoma have an initial pressure reading lower than 22 mm Hg. Intraocular pressure is not a very sensitive tool for diagnosing glaucoma, but it becomes very useful in monitoring treatment for glaucoma.

A variety of methods can be used to check the intraocular pressure, but the most common is **applanation tonometry**. Your ophthalmologist (Eye M.D.) will often set a “target” pressure for you and will work hard to keep the pressure at or below that target to help preserve your vision.

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## Gonioscopy

Because it has no noticeable symptoms, glaucoma is a difficult disease to detect without regular, complete eye exams.

During a glaucoma evaluation, your ophthalmologist (Eye M.D.) will perform a **gonioscopy**, inspecting your eye's drainage channel.

During gonioscopy, your ophthalmologist will ask you to sit in a chair facing the microscope (slit lamp) used to look inside your eye. You will place your chin on a chin rest and your forehead against a support bar while looking straight ahead. After your eye has been numbed with eyedrops, your ophthalmologist gently places the goniolens on the front of your eye and directs a narrow beam of light into your eye while looking through the slit lamp to examine the drainage angle.

Determining if the drainage angle of the eye is closed or nearly closed helps your ophthalmologist determine which type of glaucoma you have. Gonioscopy can also detect scarring or other damage to the drainage angle that may explain the cause of certain types of glaucoma.

If your ophthalmologist finds that the drainage angle is closed, a special laser can make a small opening in the iris to open the angle. Laser treatment to open the drainage angle may decrease the pressure in the eye and help control glaucoma.

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## Glaucoma—The Basics

Glaucoma is a disease of the optic nerve, which transmits the images you see from the eye to the brain. The optic nerve is made up of many nerve fibers (like an electric cable with its numerous wires). Glaucoma damages nerve fibers, which can cause blind spots and vision loss.

Glaucoma has to do with the pressure inside the eye, known as **intraocular pressure (IOP)**. When the aqueous humor (a clear liquid that normally flows in and out of the eye) cannot drain properly, pressure builds up in the eye. The resulting increase in IOP can damage the optic nerve and lead to vision loss.

The most common form of glaucoma is **primary open-angle glaucoma**, in which the aqueous fluid is blocked from flowing back out of the eye at a normal rate through a tiny drainage system. Most people who develop primary open-angle glaucoma notice no symptoms until their vision is impaired.

Ocular hypertension is often a forerunner to actual open-angle glaucoma. When ocular pressure is above normal, the risk of developing glaucoma increases. Several risk factors will affect whether you will develop glaucoma, including the level of IOP, family history, and corneal thickness. If your risk is high, your ophthalmologist (Eye M.D.) may recommend treatment to lower your IOP to prevent future damage.

In **angle-closure glaucoma**, the iris (the colored part of the eye) may drop over and completely close off the drainage angle, abruptly blocking the flow of aqueous fluid and leading to increased IOP or optic nerve damage. In acute angle-closure glaucoma there is a sudden increase in IOP due to the buildup of aqueous fluid. This condition is considered an emergency because optic nerve damage and vision loss can occur within hours of the problem. Symptoms can include nausea, vomiting, seeing halos around lights, and eye pain.

Even some people with “normal” IOP can experience vision loss from glaucoma. This condition is called **normal-tension glaucoma**. In this type of glaucoma, the optic nerve is damaged even though the IOP is considered normal. Normal-tension glaucoma is not well understood, but lowering IOP has been shown to slow progression of this form of glaucoma.

**Childhood glaucoma**, which starts in infancy, childhood, or adolescence, is rare. Like primary open-angle glaucoma, there are few, if any, symptoms in the early stage. Blindness can result if it is left untreated. Like most types of glaucoma, childhood glaucoma may run in families. Signs of this disease include:

- clouding of the cornea (the clear front part of the eye);
- tearing; and
- an enlarged eye.

Your ophthalmologist may tell you that you are at risk for glaucoma if you have one or more risk

factors, including having an elevated IOP, a family history of glaucoma, certain optic nerve conditions, are of a particular ethnic background, or are of advanced age. Regular examinations with your ophthalmologist are important if you are at risk for this condition.

The goal of glaucoma treatment is to lower your eye pressure to prevent or slow further vision loss. Your ophthalmologist will recommend treatment if the risk of vision loss is high. Treatment often consists of eyedrops but can include laser treatment or surgery to create a new drain in the eye. Glaucoma is a chronic disease that can be controlled but not cured. Ongoing monitoring (every three to six months) is needed to watch for changes. Ask your ophthalmologist if you have any questions about glaucoma or your treatment.

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## Neovascular Glaucoma

Neovascular glaucoma is a particularly aggressive and difficult to treat kind of glaucoma. It is caused by new, small blood vessels growing in the front part of the eye. These neovascularvessels grow on the surface of the iris (the colored part of the eye) and over the drainage channel, blocking the flow of fluid from the eye. This causes a rapid and painful rise in pressure within the eye. This type of glaucoma often does not respond well to medical treatment, and the high intraocular pressure can lead to a rapid loss of vision.

Causes of neovascular glaucoma include diabetic retinopathy, vein and artery occlusions, carotid artery disease, and many other conditions. The prognosis for neovascular glaucoma is poor. The goal of treatment is to minimize the factors that have caused the neovascularization, usually using a laser treatment called **panretinal photocoagulation** or **anti-VEGF** injections.

If the high eye pressure persists, treatment can include medication or surgery. When surgery is recommended, a particular type of medication therapy called **antimetabolite therapy** improves the chances of success. Because of the risk of scarring, **seton surgery** is often recommended.

The goal in treating neovascular glaucoma is to lower the intraocular pressure, preserve vision, and maintain a comfortable eye.

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## Glaucoma: People of African and Hispanic Ancestry Are at Higher Risk

If you are of African or Hispanic ancestry and especially if you have a known family member with **glaucoma**, you are at a higher risk for vision loss from this eye disease.

Glaucoma is a disease of the optic nerve, which transmits the images you see from the eye to the brain. The optic nerve is made up of numerous nerve fibers (like an electric cable made up of many wires). Glaucoma damages nerve fibers, which can cause blind spots and loss of vision.

Glaucoma has to do with the pressure inside the eye, or intraocular pressure (IOP). When the aqueous humor (the clear liquid that normally flows in and out of the eye) cannot drain properly, pressure builds up in the eye. The resulting increase in IOP can damage the optic nerve.

**Primary open-angle glaucoma** is the leading cause of blindness among people of African ancestry, occurring at a rate four times higher than among Caucasian patients. It also occurs about 10 years earlier among people of African ancestry than among Caucasians and develops more rapidly. Studies show that in the United States, African Americans between the ages of 45 and 64 are approximately 15 times more likely to go blind from glaucoma than Caucasians with glaucoma in the same age group. Primary open-angle glaucoma is also the leading cause of blindness among people of Hispanic (and especially Mexican) ancestry, occurring at a rate approaching that of people of African ancestry.

It is not clear why people of African ancestry have higher rates of glaucoma and subsequent blindness than Caucasians. One factor may be that they are more susceptible to developing elevated IOP earlier in life, which is thought to contribute to optic nerve damage and eventual vision loss. Another reason may be that they are less likely than Caucasians to have early eye examinations that might detect and treat glaucoma. This also may be a factor in the increased rate of glaucoma among Hispanics.

Glaucoma causes no symptoms early in its course; you will not experience pain or vision changes while it is developing. The best way to protect yourself and your family members against vision loss from glaucoma is by being aware of your higher risk of developing this disease and by having regular eye examinations for glaucoma at appropriate intervals.

Recommended intervals for a comprehensive eye evaluation in people of African ancestry are as follows:

- 20 to 29 years of age: every 3 to 5 years;
- 30 to 64 years of age: every 2 to 4 years;
- 65 years and older: every 1 to 2 years.

It is also recommended that people of Hispanic ancestry have regular, comprehensive eye evaluations. This is especially important after age 60.

If you are diagnosed with glaucoma, please make sure to tell your family members and urge them to have an eye exam for glaucoma.

Here are some resources for more information on glaucoma:

The Glaucoma Foundation  
80 Maiden Lane, Suite 1206  
New York , NY 10038  
Phone: 800.GLAUCOMA (452.8266)  
[www.glaucoma-foundation.org](http://www.glaucoma-foundation.org)

The National Eye Institute  
2020 Vision Place  
Bethesda , MD 20892-3655  
Phone: 301.496.5248  
[www.nei.nih.gov](http://www.nei.nih.gov)

Prevent Blindness America  
Phone: 800.331.2020  
[www.preventblindness.org](http://www.preventblindness.org)

The American Academy of Ophthalmology  
P.O. Box 7424  
San Francisco , CA 94120-7424  
[www.aaopt.org](http://www.aaopt.org)

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## Glaucoma Evaluation

Because it has no noticeable symptoms, glaucoma is a difficult disease to detect without regular, complete eye exams.

During a glaucoma evaluation, your ophthalmologist (Eye M.D.) will perform the following tests:

- **Tonometry.** Your ophthalmologist measures the pressure in your eyes (intraocular pressure, or IOP) using a technique called tonometry. Tonometry measures your IOP by determining how your cornea responds when an instrument (or sometimes a puff of air) presses on the surface of your eye. Eyedrops are usually used to numb the surface of your eye for this test.
- **Gonioscopy.** For this test, your ophthalmologist inspects your eye's drainage angle—the area where fluid drains out of your eye. During gonioscopy, you sit in a chair facing the microscope used to look inside your eye. You will place your chin on a chin rest and your forehead against a support bar while looking straight ahead. The goniolens is placed lightly on the front of your eye, and a narrow beam of light is directed into your eye while your doctor looks through the slit lamp at the drainage angle. Drops will be used to numb the eye before the test.
- **Ophthalmoscopy.** With this test, your ophthalmologist can evaluate whether or not there is any optic nerve damage by looking at the back of the eye (called the fundus). There are two types of ophthalmoscopy: direct and indirect. With **direct ophthalmoscopy**, your ophthalmologist uses a small flashlight-like instrument with several lenses that magnifies up to about 15 times. This type of ophthalmoscopy is most commonly done during a routine physical examination. With **indirect ophthalmoscopy**, the ophthalmologist wears a headband with a light attached and uses a small handheld lens to look inside your eye. Indirect ophthalmoscopy allows a better view of the fundus, even if your natural lens is clouded by cataracts.
- **Visual field test.** The peripheral (side) vision of each eye is tested with visual field testing, or **perimetry**. For this test, you sit at a bowl-shaped instrument called a perimeter. While you stare at the center of the bowl, lights flash. Each time you see a flash, you press a button. A computer records your response to each flash. This test shows if you have any areas of vision loss. Loss of peripheral vision is often an early sign of glaucoma.
- **Photography.** Sometimes photographs or other computerized images are taken of the optic nerve to inspect the nerve more closely for damage from elevated pressure in the eye.
- **Special imaging.** Different scanners may be used to better determine the configuration of the optic nerve head or retinal nerve fiber layer.

Each of these evaluation tools is an important way to monitor your vision to help ensure that glaucoma does not rob you of your sight. Some of these tests will not be necessary for everyone. Your

ophthalmologist will discuss which tests are best for you. Some tests may need to be repeated on a regular basis to monitor any changes in your vision caused by glaucoma.

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## Bleb Care After Trabeculectomy

Trabeculectomy surgery for glaucoma results in the creation of a drainage “bubble” under the upper eyelid. Aqueous fluid flows from the eye into this bubble, which is called a **bleb**. The aqueous fluid is absorbed into tiny blood vessels, keeping eye pressure low.

The bleb tissue is fragile, and it is important to take care of it to maintain proper functioning. Patients should avoid rubbing the bleb; direct contact with this area should be avoided. Patients should wear protective eyewear when engaging in sporting activities.

A bleb that functions well is often thin and is susceptible to infection. If there is any sign of redness or drainage, call your ophthalmologist (Eye M.D.) immediately. An infected bleb can lead to pain, decreased vision, and potentially even loss of vision. Patients who have had anti-scarring medication, such as **5-fluorouracil (5-FU)** or **mitomycin C**, are even more prone to infection. Your ophthalmologist will tell you if this is the case for you.

Another complication that can occur either early or late is a bleb leak. If you detect any abnormal tearing or a change in visual acuity, you need to have your eye examined by your ophthalmologist as soon as possible.

A well-functioning trabeculectomy bleb can last a lifetime. Proper care and maintenance can help ensure that the bleb continues to control your eye pressure.

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## Beta Blockers for the Treatment of Glaucoma

While there is no cure for glaucoma, it can be controlled with proper management.

Elevated intraocular pressure (IOP) can damage the optic nerve, which may lead to vision loss. Treatment for glaucoma focuses on lowering the IOP to a level that is less likely to cause further optic nerve damage. This is known as the “target pressure.” The target pressure differs from individual to individual. Your target pressure may change during your course of treatment if the progression of glaucoma is not arrested.

If you have glaucoma, your ophthalmologist (Eye M.D.) may prescribe medication to lower your eye IOP. There are many more choices for topical treatment today than there were only a few years ago. Your ophthalmologist has chosen a **beta-blocker** medication to treat your glaucoma.

### How Do Beta Blockers Work?

Beta-blocker (beta adrenergic antagonist) medications are reliable for lowering intraocular pressure. They work by decreasing the amount of fluid that the eye continually produces, called the aqueous humor. For many years, beta blockers were the mainstay of treatment. Thus, we have a lot of experience with this medication for the treatment of glaucoma.

### Types of Beta-Blocker Medications

There are two general classes of beta blockers: nonselective and selective. Nonselective beta blockers have more effects on the body’s beta receptors system-wide and are associated with more side effects. The nonselective beta blockers are also more effective at lowering IOP.

The nonselective beta blockers include

- levobunolol (Betagan, AKBeta);
- carteolol (Ocupress);
- metipranolol (Optipranolol);
- timolol (Timoptic, Betimal, Istalol); and
- timolol gel (Timoptic XE).

Generic versions of timolol and timolol gel are now available. Consult with your ophthalmologist to be sure that a generic product is an acceptable alternative for you.

The only available selective beta-blocker medication is

- betaxolol (Betoptic, Betoptic S).

Betaxolol is the generic form of Betoptic.

While a selective beta-blocker eyedrop has a better safety profile, especially in terms of respiratory symptoms, it still must be used with caution in patients with asthma or emphysema. The eye pressure-lowering effect is slightly less with selective beta blockers. There is only a minimal additive effect in terms of lowering eye pressure in patients already taking oral beta blockers, and there is the risk of further additive side effects. If you are already taking a beta-blocker medication by mouth or if your primary care doctor newly prescribes a beta blocker, please notify your ophthalmologist.

### **Possible Side Effects of Beta Blockers**

All medications, including eyedrops, can have side effects. Some people taking beta-blocker eyedrops may experience

- wheezing or difficulty breathing;
- slow or irregular heart beat or decreased response of heart rate to exercise;
- increased risk for heart failure;
- depression;
- impotence;
- headache, dizziness or weakness;
- in diabetics, difficulty sensing blood glucose changes; and
- eye irritation or allergy.

### **Medication Tips**

For glaucoma medications to work, you must take them regularly and as prescribed by your doctor. With each new medication that your ophthalmologist prescribes, make sure you understand the following:

- the name of the medication;
- how to take it;
- how often to take it;
- how to store it;
- if you can take it with your other medications (make sure all of your doctors know about all the different medications you take, including any nonprescription medications);
- what the possible side effects may be;
- what you should do if you experience side effects; and
- what you should do if you miss a dose.

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## Nerve-Fiber-Layer Analysis

Early in the disease process of glaucoma, individual nerve fibers in the eye's optic nerve are lost, causing an associated pattern of nerve-fiber-layer thinning. This problem can later translate into loss of tissue at the optic nerve head, resulting in visual field defects and, ultimately, loss of vision.

New techniques have been devised to help measure the thickness of the nerve fiber layer, helping ophthalmologists (Eye M.D.s) diagnose glaucoma earlier and monitor progression of the disease.

One technique used to measure the nerve fiber layer is called **scanning laser polarimetry**, which utilizes a device called a GDx scanner. Another technique uses a low-power laser light and a process called **optical coherence tomography (OCT)**. These new imaging techniques can help provide an objective measurement of the nerve fiber layer, enhancing the ability to effectively diagnose and monitor glaucoma.

Both tests are done in the ophthalmologist's office. During these tests, the patient is required only to remain still while the image is scanned.

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## Carbonic Anhydrase Inhibitors for the Treatment of Glaucoma

While there is no cure for glaucoma, it can be controlled with proper management.

Elevated **intraocular pressure (IOP)** can damage the optic nerve, which can lead to vision loss. Treatment for glaucoma focuses on lowering IOP to a level that is unlikely to cause further optic nerve damage. This is known as the “target pressure.” The target pressure differs from individual to individual. Your target pressure may change during your course of treatment. If you have glaucoma, your ophthalmologist (Eye M.D.) may prescribe medication to lower your eye pressure. There are many more choices for topical treatment today than there were only a few years ago. Your ophthalmologist has chosen a **carbonic anhydrase inhibitor (CAI)** medication to treat your glaucoma.

### How Do CAIs Work?

CAI medications are very reliable at lowering the intraocular pressure. They work by decreasing the production of the fluid that the eye continually makes, called the aqueous humor.

### What Are CAI Medications?

Topical drugs:

- dorzolamide (Trusopt); and
- brinzolamide (Azopt).

Oral medications:

- acetazolamide (Diamox, AK-Zol);
- acetazolamide sustained-release (Diamox Sequels); and
- methazolamide (Neptazane, GlaucoTabs).

Generic versions of the eyedrop formulations are not yet available.

### Possible Side Effects of CAIs

All medications, including eyedrops, can have side effects. Some people taking topical carbonic anhydrase medications (eyedrops) experience:

- blurred vision;
- bitter taste in the mouth;
- dry eyes;
- eye irritation or allergy with a red eye or red eyelids;
- headache or dizziness; and
- upset stomach.

The oral (pill) form of these medications has more side effects, including:

- increased need to urinate;
- tingling sensation in fingers and toes;
- rarely, severe allergic reactions or blood disorders can occur;
- change in taste (especially with carbonated beverages); and
- unusual tiredness or weakness.

## WARNING

These medications are **sulfonamides**. If you are allergic to sulfa antibiotics, the same types of adverse reactions can occur with carbonic anhydrase inhibitors. Also, rare adverse drug interactions have occurred in patients taking high doses of aspirin and carbonic anhydrase inhibitors.

For glaucoma medications to work, you must take them regularly and continuously as prescribed by your doctor.

## Medication Tips

With each new medication that your ophthalmologist prescribes, make sure you understand the following:

- the name of the medication;
- how to take it;
- how often to take it;
- how to store it;
- if you can take it with your other medications (make sure all your doctors knows about all the different medications you take, including any nonprescription medications);
- what the possible side effects may be;
- what you should do if you experience side effects; and
- what you should do if you miss a dose.

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## Argon Laser Trabeculoplasty

Argon laser trabeculoplasty (ALT) is a laser surgical procedure used for patients with open-angle glaucoma to help lower **intraocular pressure (IOP)**. ALT is used to treat the **trabecular meshwork**—the mesh-like drainage canals surrounding the iris—that serves as the eye’s drainage system. The goal of treatment with ALT is to improve the flow of fluid out of the eye, helping to lower IOP.

ALT is typically performed in the ophthalmologist’s (Eye M.D.’s) office or an outpatient surgery center. The procedure usually takes about five to ten minutes. First, anesthetic drops are placed in your eye. The laser device looks similar to the examination microscope that your ophthalmologist uses to look at your eyes at each office visit.

You will experience a flash of light with each laser application. Most people are comfortable and do not experience any significant pain during the surgery, though some may feel a little pressure in their eye during the laser procedure.

Most patients will need to have their pressure checked after the laser treatment, since there is a risk of increased eye pressure after the procedure. If this does occur, you may require medications to lower the pressure, which will be administered in the office. Rarely, IOP elevates to a very high pressure and does not come down. If this happens, you may need to have surgery to lower the pressure.

Most people notice some blurring of their vision after the laser treatment. This typically clears within a few hours. The chance of your vision becoming permanently affected from this procedure is very small.

In general, patients can resume normal daily activities the day after laser surgery. You may need to use drops after the laser surgery to help the eye heal properly.

Risks associated with ALT include

- increased pressure in the eye, possibly requiring medication or surgery to lower it;
- inflammation in the eye;
- bleeding;
- damage to the cornea, iris, or retina from the laser light;
- failure to adequately lower the eye pressure; and
- need for repeat laser surgery.

It will take several weeks to determine how much your pressure will be lowered with ALT. You may require additional laser or glaucoma drainage surgery to lower the IOP if it is not sufficiently lowered after the first laser treatment.

In most cases, medications are still necessary to control and maintain eye pressure. However, surgery may lessen the amount of medication you need.

