

## THE PHARMA INNOVATION

# Glaucoma -A Eye Disorder Its Causes, Risk Factor, Prevention and Medication

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Submitted 04.02.2012. Accepted for publication 23.02.2012.

Glaucoma refers to a group of eye conditions that lead to damage to the optic nerve, the nerve that carries visual information from the eye to the brain. In many cases, damage to the optic nerve is due to increased pressure in the eye, also known as intraocular pressure. Glaucoma is a disease of the optic nerve that affects approximately 60 million people globally. It is the second most common cause of blindness, leaving an estimated 7.5 million people blind. In India it affects 11 million people, of which 1.5 million are blind. Glaucoma is a disease that is often associated with elevated intraocular pressure, in which damage to the eye (optic) nerve can lead to loss of vision and even blindness. Glaucoma is the leading cause of irreversible blindness in the world. Glaucoma usually causes no symptoms early in its course, at which time it can only be diagnosed by regular eye examinations and screenings with the frequency of examination based on age and the presence of other risk factors. Intraocular pressure increases when either too much fluid is produced in the eye or the drainage or outflow channels of the eye become blocked. While anyone can get glaucoma, some people are at greater risk. The two main types of glaucoma are open-angle glaucoma, which has several variants and is a long duration condition, and angle-closure glaucoma, which may be a sudden condition or a chronic disease. Damage to the optic nerve and impairment of vision from glaucoma is irreversible. Several painless tests that determine the intraocular pressure, the status of the optic nerve and drainage angle, and visual fields are used to diagnose glaucoma. Glaucoma is usually treated with eye drops, although lasers and surgery can also be used. Most cases can be controlled well with these treatments, thereby preventing further loss of vision. Much research into the causes and treatment of glaucoma is being carried out throughout the world. Early diagnosis and treatment is the key to preserving sight in people with glaucoma.

*Keyword:* Glaucoma, optic nerve, blindness, impairment of vision.

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**INTRODUCTION:** Glaucoma is a disease of the major nerve of vision, called the optic nerve. The optic nerve receives light-generated nerve impulses from the retina and transmits these to the brain, where we recognize those electrical

signals as vision. Glaucoma is characterized by a particular pattern of progressive damage to the optic nerve that generally begins with a subtle loss of side vision (peripheral vision). If glaucoma is not diagnosed and treated, it can progress to loss of central vision and blindness. Glaucoma is usually, but not always, associated with elevated pressure in the eye (intraocular pressure). Generally, it is this elevated eye pressure that leads to damage of the eye (optic) nerve. In some cases, glaucoma may occur in the presence of normal eye pressure. This form of glaucoma is believed to be caused by poor regulation of blood flow to the optic nerve. New eye drops will continue to become available for the treatment of glaucoma. Some drops will be new classes of agents. Other drops will combine some already existing agents into one bottle to achieve an additive effect and to make it easier and more economical for patients to take their medication. Many researchers are investigating the therapeutic role of neuroprotection of the optic nerve, especially in patients who seem to be having progressive nerve damage and visual field loss despite relatively normal intraocular pressures. Animal models have shown that certain chemical mediators can reduce injury or death of nerve cells. Proving such a benefit for the human optic nerve, however, is more difficult because, for one thing, biopsy or tissue specimens are not readily available. Nevertheless, if any of these mediators in eye drops can be shown to protect the human optic nerve from glaucomatous damage, this would be a wonderful advance in preventing blindness. In other studies, new surgical methods are being evaluated to lower the intraocular pressure more safely without significant risk of damage to the eye or loss of vision. Finally, increased efforts to enhance public awareness of glaucoma, national free screenings for those individuals at risk, earlier diagnosis and treatment and better compliance

with treatment are our best hopes to reduce vision loss from glaucoma. It is important to realize that there is no cure for glaucoma. Once nerve fibers die and visual function is lost, it cannot be recovered. Treatment can only help preserve remaining vision; hence it is imperative to detect the disease in its earliest stage. The management of glaucoma must be an individualized effort. Simplistically speaking, in angle closure glaucoma doctors use a laser to create an alternative path for the fluid to drain out. However, this approach works for early cases; advanced cases require medication and surgery as for open angle glaucoma. An attack of closed angle glaucoma is an emergency and the IOP must be lowered as soon as possible to prevent damage to the optic nerve. For open angle glaucoma, initially eye drops are used to lower IOP; your doctor will select the one most suited for your condition. If the disease is advanced, and/or medical treatment fails, surgery may be necessary. Medical therapy is expensive, and likely to be life-long. As with any treatment, there is a risk of side effects. Sometimes the side effects may be more uncomfortable for the patient, and less acceptable, than living with the disease. Therefore doctors consider the risk-benefit ratio of the treatment options for glaucoma. The main criterion is how much functional capacity is affected rather than the actual degree of vision loss. Your doctor will select the treatment most suited for your condition, please follow the advice meticulously. In some patients glaucoma may be controlled by medicine alone, while others may need laser treatment or surgery. Surgery usually involves cutting a piece of tissue from the angle of the eye and allowing the fluid to accumulate under the transparent skin that surrounds the eyeball. However, glaucoma surgery is not as predictable as cataract surgery and carries more risks, including loss of the eye from devastating

bleeding or infection. It is usually used if drugs fail to control eye pressure, or for socioeconomic considerations. Non-penetrating surgery can also help decrease eye pressure and has fewer complications than the standard approach. But its results are not as good. Hence it is not a first line of treatment for glaucoma. In cases with poor potential for visual recovery or function, a different kind of laser may be used to reduce eye pressure. This is usually reserved for advanced cases.

### CAUSES OF GLAUCOMA

The eye is filled with aqueous humour and vitreous humour.

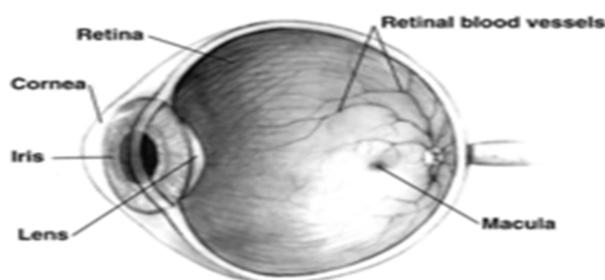


Figure No. 1: Human eye cross sectional view

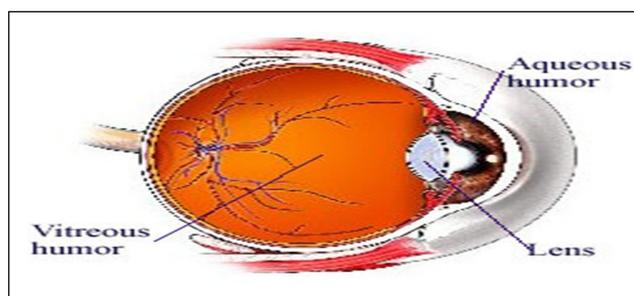


Figure No. 2: Structure of eye.

Aqueous humour is a clear fluid in the front part of the eye. Vitreous humour is clear, jelly-like substances that fills the eye behind the lens and helps the eyeball keep its shape. In a normal eye, aqueous humour is produced, circulates through

the eye, and then drains out through the trabecular meshwork, which is the eye's filtration system. This is a series of tiny channels near the angle formed by the cornea (the clear portion of the eye), the iris (the colored portion of the eye), and the sclera (the white of the eye). If there is any sort of blockage in these channels, pressure builds up inside the eyeball.

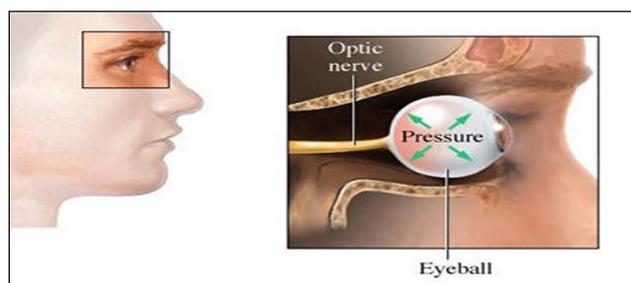


Figure No. 3: Glaucoma eye.

Untreated pressure in the eye can damage and eventually destroy the optic nerve leading to blindness. But, surprisingly, there are some people who suffer from glaucoma even though they have normal pressure in their eyes. There also are people who have pressure in their eyes and yet do not suffer from glaucoma. Researchers are still trying to figure out why. Somewhere between 20 and 25 percent of people with glaucoma have normal (and maybe even low) eye pressure, some people with high eye pressure, which is also called ocular hypertension, do not have glaucoma, and never will. There are several causes for glaucoma. Ocular hypertension (increased pressure within the eye) is the largest risk factor in most glaucomas, but in some populations, only 50% of people with primary open angle glaucoma actually have elevated ocular pressure.

### **Dietary**

There is no clear evidence that vitamin deficiencies cause glaucoma in humans. It follows, then, that oral vitamin supplementation is not a recommended treatment for glaucoma. Caffeine increases intraocular pressure in those with glaucoma but does not appear to affect normal individuals.

### **Ethnicity**

Many East Asian groups are prone to developing angle closure glaucoma due to their shallower anterior chamber depth, with the majority of cases of glaucoma in this population consisting of some form of angle closure.<sup>[8]</sup> Inuit also have a 20 to 40 times higher risk than Caucasians of developing primary angle closure glaucoma. Women are three times more likely than men to develop acute angle closure glaucoma due to their shallower anterior chambers. Those of African descent are three times more likely to develop primary open angle glaucoma.

### **Genetics**

Various rare congenital/genetic eye malformations are associated with glaucoma. Occasionally, failure of the normal third trimester gestational atrophy of the hyaloid canal and the tunica vasculosa lentis is associated with other anomalies. Angle closure induced ocular hypertension and glaucomatous optic neuropathy may also occur with these anomalies and modelled in mice. Primary open angle glaucoma (POAG) has been found to be associated with mutations in genes at several loci. Normal tension glaucoma, which comprises one third of POAG, is associated with genetic mutations. People with a family history of glaucoma have about six percent chance of developing glaucoma. Glaucoma can be hereditary, although having

people in your family with glaucoma does not necessarily mean that you will develop it

### **Other**

Other factors can cause glaucoma, known as "secondary glaucomas", including prolonged use of steroids (steroid-induced glaucoma); conditions that severely restrict blood flow to the eye, such as severe diabetic retinopathy and central retinal vein occlusion (neovascular glaucoma); ocular trauma (angle recession glaucoma); and uveitis (uveitic glaucoma).

## **TYPES OF GLAUCOMA**

There are many different types of glaucoma. Most, however, can be classified as either open-angle glaucomas, which are usually conditions of long duration (chronic), or angle-closure (closed angle) glaucomas, which include conditions occurring both suddenly (acute) and over a long period of time (chronic). The glaucomas usually affect both eyes, but the disease can progress more rapidly in one eye than in the other. Involvement of just one eye occurs only when the glaucoma is brought on by factors such as a prior injury, inflammation, or the use of steroids only in that eye.

### **Open-angle glaucoma Primary chronic open-angle glaucoma (COAG)**

It is by far the most common type of glaucoma. Moreover, its frequency increases greatly with age. This increase occurs because the drainage mechanism gradually may become clogged with aging, even though the drainage angle is open. As a consequence, the aqueous fluid does not drain from the eye properly. The pressure within the eye, therefore, builds up painlessly and without symptoms. Furthermore, as mentioned

previously, since the resulting loss of vision starts on the side (peripherally), people are usually not aware of the problem until the loss encroaches on their central visual area.

**Normal tension (pressure) glaucoma or low tension glaucoma** are variants of primary chronic open-angle glaucoma that are being recognized more frequently than in the past. This type of glaucoma is thought to be due to decreased blood flow to the optic nerve. This condition is characterized by progressive optic-nerve damage and loss of peripheral vision (visual field) despite intraocular pressures in the normal range or even below normal. This type of glaucoma can be diagnosed by repeated examinations by the eye doctor to detect the nerve damage or the visual field loss.

**Congenital (infantile) glaucoma** is a relatively rare, inherited type of open-angle glaucoma. In this condition, the drainage area is not properly developed before birth. This results in increased pressure in the eye that can lead to the loss of vision from optic-nerve damage and also to an enlarged eye. The eye of a young child enlarges in response to increased intraocular pressure because it is more pliable than the eye of an adult. Early diagnosis and treatment with medicine and/or surgery are critical in these infants and children to preserve their sight.

**Secondary open-angle glaucoma** is another type of open-angle glaucoma. It can result from an eye (ocular) injury, even one that occurred many years ago. Other causes of secondary glaucoma are inflammation in the iris of the eye (iritis), diabetes, cataracts, or in steroid-susceptible individuals, the use of topical (drops) or systemic (oral or injected) steroids (cortisone). It can also be associated with a retinal detachment or retinal vein occlusion or blockage.

(The retina is the layer that lines the inside of the back of the eye.) The treatments for the secondary open-angle glaucomas vary, depending on the cause.

**Pigmentary glaucoma** is a type of secondary glaucoma that is more common in younger men. In this condition, for reasons not yet understood, granules of pigment detach from the iris, which is the colored part of the eye. These granules then may block the trabecular meshwork, which, as noted above, is a key element in the drainage system of the eye. Finally, the blocked drainage system leads to elevated intraocular pressure, which results in damage to the optic nerve.

**Exfoliative glaucoma** (pseudoexfoliation) is another type of glaucoma that can occur with either open or closed angles. This type of glaucoma is characterized by deposits of flaky material on the front surface of the lens (anterior capsule) and in the angle of the eye. The accumulation of this material in the angle is believed to block the drainage system of the eye and raise the eye pressure. While this type of glaucoma can occur in any population, it is more prevalent in older people and people of Scandinavian descent. It is recently been shown to often be associated with hearing loss in older people.

### **Angle-closure glaucoma**

Angle-closure glaucoma is a less common form of glaucoma in the Western world but is extremely common in Asia. Angle-closure glaucoma may be acute or chronic. The common element in both is that a portion or all of the drainage angle becomes anatomically closed, so that the aqueous fluid within the eye cannot even reach all or part of the trabecular meshwork. In acute angle-closure glaucoma, the patient's

intraocular pressure, which ordinarily is normal, can go up very suddenly (acutely). This sudden pressure increase occurs because the drainage angle becomes closed and blocks off all the drainage channels. This type of glaucoma can occur when the pupil dilates (widens or enlarges). As a result, the peripheral edge of the iris can become bunched up against its corneal attachment, thereby causing the drainage angle to close. Thus, the problem in angle-closure glaucoma is the difficulty with access of the eye fluid to the drainage system (trabecular meshwork). In contrast, remember that the problem in open-angle glaucoma is clogging within the drainage system itself. In chronic open-angle glaucoma, portions of the drainage angle become closed over a long period of time. As more and more areas become closed, the pressure within the eye rises, often over a period of months or years.

People with small eyes are predisposed to developing angle-closure glaucoma because they tend to have narrow drainage angles. Small eyes are not obvious from their appearance, but they can be measured by an eye doctor. Thus, individuals who are farsighted or of Asian descent may have small eyes, narrow drainage angles, and an increased risk of developing angle-closure glaucoma. Furthermore, this condition may be acutely triggered by medications that can dilate the pupils. These agents can be found in certain eyedrops, cold remedies, citalopram (Celexa), topiramate (Topamax), or patches used to prevent seasickness. This condition can also occur spontaneously in a darkened room or a movie theater, when the pupil automatically dilates to let in more light. Sometimes, therefore, people with narrow angles are given eyedrops to keep their pupils small. (See the section below on parasympathomimetic agents.)

An attack of acute angle-closure glaucoma may be associated with severe eye pain and headache, a red (inflamed) eye, nausea, vomiting, and blurry vision. In addition, the high intraocular pressure leads to corneal swelling (edema), which causes the patient to see haloes around lights. Sometimes, acute glaucoma is treated with oral carbonic anhydrase inhibitors. (See the section below on these medications.) An attack of acute glaucoma, however, is usually relieved by eye surgery. In this operation, the doctor makes a small hole in the iris with a laser (laser iridotomy) to allow the fluid to resume draining into its normal outflow channels.

## SYMPTOMS AND SIGNS

Patients with open-angle glaucoma and chronic angle-closure glaucoma in general have no symptoms early in the course of the disease. Visual field loss (side vision loss) is not a symptom until late in the course of the disease. Rarely patients with fluctuating levels of intraocular pressure may have haziness of vision and see haloes around lights, especially in the morning. On the other hand, the symptoms of acute angle-closure are often extremely dramatic with the rapid onset of severe eye pain, headache, nausea and vomiting, and visual blurring. Occasionally, the nausea and vomiting exceed the ocular symptoms to the extent that an ocular cause is not contemplated. The eyes of patients with open-angle glaucoma or chronic angle-closure glaucoma may appear normal in the mirror or to family or friends. Some patients get slightly red eyes from the chronic use of eye drops. The ophthalmologist, on examining the patient, may find elevated intraocular pressure, optic-nerve abnormalities, or visual field loss in addition to other less common signs. The eyes of patients with acute angle-closure glaucoma will

appear red, and the pupil of the eye may be large and nonreactive to light. The cornea may appear cloudy to the naked eye. The ophthalmologist will typically find decreased visual acuity, corneal swelling, highly elevated intraocular pressure, and a closed drainage angle.

### OPEN-ANGLE GLAUCOMA

- Most people have NO symptoms until they begin to lose vision
- Gradual loss of peripheral (side) vision (also called tunnel vision)

### ANGLE-CLOSURE GLAUCOMA

- Symptoms may come and go at first, or steadily become worse
- Sudden, severe pain in one eye
- Decreased or cloudy vision
- Nausea and vomiting
- Rainbow-like halos around lights
- Red eye
- Eye feels swollen

### CONGENITAL GLAUCOMA

- Symptoms are usually noticed when the child is a few months old
- Cloudiness of the front of the eye
- Enlargement of one eye or both eyes
- Red eye
- Sensitivity to light
- Tearing

### RISK FACTOR

Glaucoma is often called "the sneak thief of sight." This is because, as already mentioned, in most cases, the intraocular pressure can build up

and destroy sight without causing obvious symptoms. Thus, awareness and early detection of glaucoma are extremely important because this disease can be successfully treated when diagnosed early. While everyone is at risk for glaucoma, certain people are at a much higher risk and need to be checked more frequently by their eye doctor. The major risk factors for glaucoma include the following:

- High Intraocular (Eye) Pressure
- Age 50 or older
- Family history of glaucoma
- African Americans
- Suspicious optic nerve appearance (cupping > 50% or asymmetry)
- Thin cornea
- High Myopia (nearsightedness)
- Diabetes
- Hypertension
- Eye Injury or Surgery
- History of steroid use
- Migraine, headaches
- Sleep apnea

### DIAGNOSIS OF GLAUCOMA

Since the treatment methods for open angle and angle closure glaucoma are different, it is important to identify the mechanism involved. The diagnosis (or exclusion) of glaucoma requires a detailed and comprehensive eye examination. Your doctor will do the following examinations:

To detect glaucoma your doctor will conduct the following examinations:

- a routine vision test that requires reading letters from a chart,
- Slit lamp (microscope) examination: This special microscope is the

ophthalmologist's stethoscope and all patients, not just those suspected of having glaucoma, must undergo a slit lamp examination.

- The pressure inside the eye is measured with an 'applanation tonometer' attached to the slit lamp. A hand held version of the instrument is also effective. It may be necessary to obtain multiple readings of the pressure during the course of the day and at night. The older method of resting an instrument on the cornea while the patient lies down is not accurate. The newer non-contact air soft (computerized) instrument may be good for screening but cannot be used for diagnosis or for the treatment of glaucoma.
- An examination of the angle of the eye is done with the help of a gonioscope. This is a contact lens placed on the eye to examine the angle of the eye. Its use is mandatory in determining the type of glaucoma - open angle or angle closure.
- The above two steps require the use of drops to eliminate sensation in the eye. The drops may burn a little bit.
- An optic disc examination on a dilated eye is also required. The doctor will usually administer eye drops to dilate the pupil, facilitating an examination of the optic disc and the back of the eye, the retina. For obtaining a stereoscopic view on the microscope, a hand-held lens or a contact lens is the best method. A computerized scan of the optic disc may also be done.
- To confirm the diagnosis, the doctor will conduct an automated field or perimetry test. Damage to the optic nerve limits the field of vision, but regular vision, i.e. the ability to read an ophthalmologist's eye

chart, is affected at a much later stage. In its early stages glaucoma can only be detected or monitored by using an automated perimetry test. A normal patient will have a 'full field vision', while a person with glaucoma has black, non-seeing areas in the field of vision.

Many people have difficulty doing the perimetry test at first, and may be better at it the second or the third time. Baseline tests are necessary for future comparison and periodic examinations are essential to check the progression of the disease. Considering the importance of the test, ANY automated perimeter is NOT acceptable. The field test is a subjective test and it is important to have a calibrated machine with an appropriate normal database against which to compare your results. Sometimes a diagnosis may not be possible on one visit. In very early cases it may be necessary to repeat the entire examination after a period of observation. An eye doctor (ophthalmologist) can usually detect those individuals who are at risk for glaucoma (because of, for example, a narrow drainage angle or increased intraocular pressure) before nerve damage occurs. The doctor also can diagnose patients who already have glaucoma by observing their nerve damage or visual field loss.

The following tests, all of which are painless, may be part of this evaluation.

### **Tonometry**

- **Tonometry** determines the pressure in the eye by measuring the tone or firmness of its surface. Several types of tonometers are available for this test, the most common being the applanation tonometer. After the eye has

been numbed with anesthetic eyedrops, the tonometer's sensor is placed against the front surface of the eye. The firmer the tone of the surface of the eye, the higher the pressure reading.

### **Pachymetry**

- **Pachymetry** is a relatively new test being used for the diagnosis and treatment of glaucoma. Pachymetry determines the thickness of the cornea. After the eye has been numbed with anesthetic eyedrops, the pachymeter tip is touched lightly to the front surface of the eye (cornea). Recent studies have shown that corneal thickness can affect the measurement of intraocular pressure. Thicker corneas may give falsely high eye pressure readings and thinner corneas may give falsely low pressure readings. Furthermore, thin corneas may be an additional risk factor for glaucoma.

### **Gonioscopy**

- **Gonioscopy** is done by numbing the eye with anesthetic drops and placing a special type of contact lens with mirrors inside the eye. The mirrors enable the doctor to view the interior of the eye from different directions. The purpose of this test is to examine the drainage angle and drainage area of the eye. In this procedure, the doctor can determine whether the angle is open or narrow and find any other abnormalities within the angle area. As indicated earlier, individuals with narrow angles have an increased risk for a sudden closure of the angle, which can cause an acute angle-closure glaucomatous attack. Gonioscopy can also determine if anything, such as abnormal blood vessels, might be blocking the drainage of the aqueous fluid out of the eye.

### **Ophthalmoscopy**

- **Ophthalmoscopy** is an examination in which the doctor uses a handheld device to look directly through the pupil (the opening in the colored iris) into the eye. This procedure is done to examine the optic nerve (seen as the optic disc) at the back of the eye. Damage to the optic nerve, called cupping of the disc, can be detected in this way. Cupping, which is an indentation of the optic disc, can be caused by increased intraocular pressure. Additionally, a pale color of the nerve can suggest damage to the nerve from poor blood flow or increased intraocular pressure. Special cameras can be used to take photographs of the optic nerve to compare changes over time.

### **Visual Field testing**

- **Visual Field testing** actually maps the visual fields to detect any early (or late) signs of glaucomatous damage to the optic nerve. This test can be grossly done by having the patient look straight ahead with one eye covered and count the fingers shown by the examiner from the side. More typically, however, visual fields are measured by a computerized assessment. For this procedure, one eye is covered and the patient places his or her chin in a type of bowl. Then, when the patient sees lights of various intensities and at different locations, he or she pushes a button. This process produces a computerized map of the visual field, outlining the areas where the eye can or cannot see. Other, more sophisticated tests may also be employed. All of these tests need to be repeated at intervals to assess the progress of the disease and the effect of the treatment.

### **GLAUCOMA MEDICATIONS**

Beta-adrenergic antagonists act against, or block, adrenalin-like substances. These drops work in

the treatment of glaucoma by reducing the production of the aqueous humor. For years, they have been the gold standard (to which other agents are compared) for treating glaucoma.

These medications include timolol (Timoptic), levobunolol (Betagan), carteolol (Ocupress), and metipranolol (Optipranolol).

Used once or twice daily, these drops are very effective. However, side effects, such as the worsening of asthma or emphysema, bradycardia (slow heart rate), low blood pressure, fatigue, and impotence prohibit their use in some patients. Betaxolol (Betoptic) is a beta-adrenergic antagonist that is more selective in working just on the eye and, therefore, carries less risk of heart (cardiac) or lung (pulmonary) side effects than other drops of this type. Prostaglandin analogs are similar in chemical structure to the body's prostaglandins. Prostaglandins are hormone-like substances that are involved in a wide range of functions throughout the body. These drops work in glaucoma by increasing the outflow (drainage) of fluid from the eye. The prostaglandin analogs have replaced timolol as the most commonly prescribed drops for glaucoma. They can be used just once a day. This class of medications has fewer systemic (involving the rest of the body) side effects than timolol, but can change the color of the iris as well as thicken and darken the eyelashes. These drops are also more likely to cause redness of the eyes than some other classes of eyedrops. In some patients, they may also cause inflammation inside the eye.

Adrenergic agonists are a type of drops that act like adrenalin. They work in glaucoma by both reducing the production of fluid by the eye and increasing its outflow (drainage). The most popular adrenergic agonist is brimonidine (Alphagan). However, there is at least a 12% risk of significant local (eye) allergic

reactions. Other members of this class of drops include epinephrine, dipivefrin (Propine) and apraclonidine (Iopidine).

Carbonic anhydrase inhibitors work in glaucoma by reducing the production of fluid in the eye. Eye drop forms of this type of medication include dorzolamide (Trusopt) and brinzolamide (Azopt). They are used two or three times daily. Carbonic anhydrase inhibitors may also be used as pills (systemically) to remove fluid from the body, including the eye. Oral forms of these medications used for glaucoma include acetazolamide (Diamox) and methazolamide (Neptazane). Their use in this condition, however, is limited due to their systemic (throughout the body) side effects, including reduction of body potassium, kidney stones, numbness or tingling sensations in the arms and legs, fatigue, and nausea.

Parasympathomimetic agents, which are also called miotics because they narrow (constrict) the pupils, act by opposing adrenalin-like substances. They work in glaucoma by increasing the aqueous outflow from the eye. These drops include pilocarpine (Salagen), demecarium (Humorsol), echothiophate (Phospholine Iodide), and isofluorophate (Floropryl).

The parasympathomimetics had been used for many years to treat glaucoma, but they are currently out of favor because they need to be used three to four times a day and produce side effects in the eye. These side effects include a small pupil, blurred vision, an aching brow, and an increased risk of retinal detachment. Currently, pilocarpine is the only one of these medications being used for glaucoma. It is used primarily to keep the pupil small in patients with a particular iris configuration (plateau iris) or in patients with a narrow angle prior to laser iridotomy. (See the section above on angle-closure glaucoma.)

Osmotic agents are an additional class of medications used to treat sudden (acute) forms of glaucoma where the eye pressure remains extremely high despite other treatments. These medications include isosorbide (Ismotic, given by mouth) and mannitol (Osmitrol, given through the veins). These medications must be used cautiously as they have significant side effects, including nausea, fluid accumulation in the heart and/or lungs (congestive heart failure and/or pulmonary edema), bleeding in the brain, and kidney problems. Their use is prohibited in patients with uncontrolled diabetes, heart, kidney, or liver problems.

Ophthalmologists often prescribe an eyedrop containing more than one class of drug to patients who require more than one type of drug for control of their glaucoma. This simplifies the taking of drops by the patient. The most common example of this is the combination of timolol and dorzolamide in the same drop (Cosopt).

Several new classes of glaucoma drops are currently under development or awaiting FDA approval. Although marijuana use has been shown to reduce intraocular pressure, eyedrops are available which accomplish the same purpose with greater efficacy and less systemic risk.

### **Glaucoma surgery or laser**

There are several forms of laser therapy for glaucoma. Laser iridotomy (see the section above on angle-closure glaucoma) involves making a hole in the colored part of the eye (iris) to allow fluid to drain normally in eyes with narrow or closed angles. Laser trabeculoplasty is a laser procedure performed only in eyes with open angles. Laser trabeculoplasty does not cure glaucoma but is often done instead of increasing the number of different eyedrops or when a patient's intraocular pressure is felt to be too high

despite the use of multiple eyedrops (maximal medical therapy). In some cases, it is used as the initial or primary therapy for open-angle glaucoma. This procedure is a quick, painless, and relatively safe method of lowering the intraocular pressure. With the eye numbed by anesthetic drops, the laser treatment is applied through a mirrored contact lens to the angle of the eye. Microscopic laser burns to the angle allow fluid to better exit the drainage channels.

Laser trabeculoplasty is often done in two sessions, weeks or months apart. Unfortunately, the improved drainage as a result of the treatment may last only about two years, by which time the drainage channels tend to clog again. There are two types of laser trabeculoplasty: argon laser trabeculoplasty (ALT) and selective laser trabeculoplasty (SLT). ALT is generally not repeated after the second session due to the formation of scar tissue in the angle. SLT is less likely to produce scarring in the angle, so, theoretically, it can be repeated multiple times. However, the likelihood of success with additional treatments when prior attempts have failed is low. Thus, the options for the patient at that time are to increase the use of eyedrops or proceed to surgery.

Laser cyclo-ablation (also known as ciliary body destruction, cyclophotocoagulation or cyclocryopexy) is another form of laser treatment generally reserved for patients with severe forms of glaucoma with poor visual potential. This procedure involves applying laser burns or freezing to the part of the eye that makes the aqueous fluid (ciliary body). This therapy destroys the cells that make the fluid, thereby reducing the eye pressure. This type of laser is typically performed after other more traditional therapies have failed.

## **Glaucoma surgery**

Trabeculectomy is a delicate microsurgical procedure used to treat glaucoma. In this operation, a small piece of the clogged trabecular meshwork is removed to create an opening and a new drainage pathway is made for the fluid to exit the eye. As part of this new drainage system, a tiny collecting bag is created from conjunctival tissue. (The conjunctiva is the clear covering over the white of the eye.) This bag is called a "filtering bleb" and looks like a cystic raised area that is at the top part of the eye under the upper lid. The new drainage system allows fluid to leave the eye, enter the bag/bleb, and then pass into the capillary blood circulation (thereby lowering the eye pressure). Trabeculectomy is the most commonly performed glaucoma surgery. If successful, it is the most effective means of lowering the eye pressure.

Aqueous shunt devices (glaucoma implants or tubes) are artificial drainage devices used to lower the eye pressure. They are essentially plastic microscopic tubes attached to a plastic reservoir. The reservoir (or plate) is placed beneath the conjunctival tissue. The actual tube (which extends from the reservoir) is placed inside the eye to create a new pathway for fluid to exit the eye. This fluid collects within the reservoir beneath the conjunctiva creating a filtering bleb. This procedure may be performed as an alternative to trabeculectomy in patients with certain types of glaucoma.

Viscocanalostomy is an alternative surgical procedure used to lower eye pressure. It involves removing a piece of the sclera (eye wall) to leave only a thin membrane of tissue through which aqueous fluid can more easily drain. While it is less invasive than trabeculectomy and aqueous shunt surgery, it also tends to be less effective.

The surgeon sometimes creates other types of drainage systems. While glaucoma surgery is often effective, complications, such as infection or bleeding, are possible. Accordingly, surgery is usually reserved for cases that cannot otherwise be controlled.

## **TREATMENT OF GLAUCOMA**

Glaucoma can be treated, and the sooner the better. The damage that has already occurred from glaucoma cannot be repaired-it will either stay the same or get worse. Catching glaucoma at its earliest stages and treating it promptly will increase the odds of keeping one's vision. All of the various glaucoma treatments and procedures are aimed at reducing eye pressure. Eye pressure doesn't necessarily cause glaucoma, but once it develops, eye pressure speeds up the destructive process. There are a number of different treatments for glaucoma:

- Eye drops
- Oral medication
- Surgery

The type of treatment depends upon individual conditions.

## **EYE DROPS**

Eye drops are used to reduce eye pressure by either increasing the eye's ability to drain or by decreasing the amount of fluid it produces. Medications that are applied directly to the eye are usually in the form of eye drops, but sometimes ointments may be used. There are six different types of medications that are administered to the eye to treat glaucoma:

- **Beta-blockers** cause little discomfort and work by decreasing the production of aqueous fluid. However, they can make breathing and heart problems worse in people with heart or lung conditions.
- **Prostaglandins** increase drainage. They can cause blue and green eyes to become darker.
- **Alpha-stimulators** are used with other medications to lower eye pressure. These can cause allergic reactions in and around the eyes.
- **Carbonic anhydrase inhibitors** decrease fluid production. Because they are sulphur based, they should not be used by people allergic to sulphur.
- **Miotics** increase fluid drainage. They can, however, cause headaches when first used. They also cause the pupil to constrict-shrink-which can cause blurred vision.
- **Epinephrine** increases fluid drainage. Although there are not usually any major complications, it can cause temporary redness of the eye and blurred vision.

**Drugs Used in Glaucoma:** The following drugs are used in the glaucoma treatment

### 1. Sympathomimetics:

- 1) Apraclonidine
- 2) Brimonidine
- 3) Clonidine
- 4) Dipivefrin
- 5) Epinephrine

### 2. Parasympathomimetics:

#### A. Muscarinic:

- 1) Aceclidine

#### B. Muscarinic/Nicotinic:

- 1) Acetylcholine
- 2) Carbachol

#### C. Acetyl cholinesterase inhibitors:

- 1) Demecarium
- 2) Ecothiopate
- 3) Stigmine (Neostigmine. Physostigmine)
- 4) Paraoxon

### 3. Carbonic anhydrase inhibitors:

- 1) Acetazolamide
- 2) Brinzolamide
- 3) Dichlorofenamide
- 4) Dorzolamide
- 5) Methazolamide

### 4. Beta blocking agents:

- 1) Befunolol
- 2) Betaxolol
- 3) Carteolol
- 4) Levobunolol
- 5) Metipranolol
- 6) Timolol

### 5. Prostaglandin analogues:

- 1) Bimatoprost
- 2) Latanoprost
- 3) Travoprost

The glaucoma treatment itself is not exhaustive and brings pleasurable experience to the person that has decided to treat glaucoma. I understand that it sounds surprising, but this is the path that I walked through when I started research on natural glaucoma treatment options.

- a. I thought that if glaucoma is caused by the elevated pressure in the eye the first aid to the eye would be to reduce the amount of pressure. Watch the video with Relaxation Eye Exercises to learn at least half of them. They are all easy to learn, quick and fun to do.
- b. The biggest help for the eyes with glaucoma eye problem is water procedures. Learn about contrast eye bathing, eye icing, eye rejuvenating procedure and incorporate these easy tasks into your glaucoma treatment plan. Here is one of the yoga methods to fight intraocular pressure. Each morning or more frequently go to the bath, open the cold water in the sink, fill your mouth with cold water and, while you hold water inside, splash your eyes with running cold water. This stimulates blood flow in the eyes and relieves the pressure.
- c. The last, but not the least is nutritional advice.  
Most people, especially with low-tension glaucoma, have also other vascular problems. They are usually due to poor eating habits, lack of vitamins and minerals. Read carefully about herbal medicine, particularly about schizandra and bilberry. Vitamin C, taken in dosages up to bowel tolerance, is reported to reduce pressure within the eye and restore collagen balance. Vitamin C supplements with bioflavonoids, especially rutin and lutein, are particularly recommended.
- d. Add schizandra into your tea. Drink plenty of green tea of good quality. Make green or white tea out of loose tea leaves. Incorporate Raw Food into your life as much as possible (the recipes are here

## CONCLUSION

The modern goals of glaucoma management are to avoid glaucomatous damage and nerve damage, and preserve visual field and total quality of life for patients with minimal side effects. This requires appropriate diagnostic techniques and follow-up examinations and judicious selection of treatments for the individual patient. Although intraocular pressure is only one of the major risk factors for glaucoma, lowering it via various pharmaceuticals and/or surgical techniques is currently the mainstay of glaucoma treatment. Vascular flow and neurodegenerative theories of glaucomatous optic neuropathy have prompted studies on various neuroprotective therapeutic strategies, including nutritional compounds, some of which may be regarded by clinicians as safe for use now, while others are on trial.

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**Journal:** The Pharma Innovation

**Website:** [www.thepharmajournal.com](http://www.thepharmajournal.com)

**Volume:** 1

**Issue:** 1

**Year:** 2012

**Page no.:** 66- 81

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