

Glaucoma

Glaucoma

Definition

Glaucoma is a relatively frequent eye disease characterized by an increase in fluid pressure inside the eye. This increase in fluid pressure is due to an obstruction of the trabeculum filter, which facilitates the evacuation of intraocular fluid. Progressively, this excess pressure damages the delicate fibres of the optic nerve, causing slow deterioration of the field of vision and eventual blindness¹.

According to the origins of the increase in intraocular pressure (IOP), various kinds of glaucoma are defined, including the primary glaucoma, of particular interest, and the secondary glaucoma.

The primary glaucoma, divided into 2 categories:

- On the one hand, **primary angle-closure glaucoma**, resulting from a blockage of the aqueous humor draining, this leads to a significant increase in IOP. Among them, there are mainly:
 - Acute glaucoma**, due to papillary blocking, which prevents the aqueous humor pupillary transit when the iris and the crystalline lens are coming closer together, or to the plateau iris syndrome, an abnormal morphology of the iris which prevents the evacuation of aqueous humor.
 - Subacute glaucoma**, a moderate acute glaucoma which iridocorneal angle is not totally closed. In this case, the IOP and the symptoms are alleviated.
 - Chronic glaucoma**, i.e., a continually high IOP, resulting from a narrow iridocorneal angle, closed in several places called synechies.
- On the other hand, the **primitive open-angle glaucoma** (because the iridocorneal angle is open), which are always chronics. These are the most frequent and we distinguish among them:
 - The **high IOP glaucoma**, leading to the progressive death of nerve cells and a decrease in visual field. In this case, high IOP is not due to a closed iridocorneal angle but to a congestion of the trabeculum.
 - The **high IOP glaucoma with neither visible glaucomatous alteration nor simple ocular hypertension**. In this case, there is still no symptoms yet, but the IOP is high and the risk that they appear is serious.
 - Normal IOP glaucoma**, which is not very different from the high IOP glaucoma since the damages are similar and the treatments are more or less the same. However, there are specific alterations of the normal IOP glaucoma, that will help your eye specialist to diagnose it.
- The **secondary glaucoma**, successive to another eye disease or treatment.

Note:

The optic nerve, which connects the eye to the brain, ensures the transmission of signals from the retina to the central nervous system where they are processed as images.

• Epidemiology

Glaucoma is a common medical condition, as it affects approximately 2% of the population. In Belgium, 2% of subjects older than 40 years of age suffer from glaucoma². In Morocco, 400,000 subjects are affected by open-angle glaucoma³. In the United States, it is estimated that 2.2 million Americans (1.86% of the population) older than 40 years of age present open-angle glaucoma⁴. In France, almost 600,000 people are diagnosed with glaucoma, and the disease is present in another 400,000 people who are not aware of it⁵.

Its frequency increases with age, and it occurs especially after the age of 50, but also affects children⁵. In this case, it is called congenital glaucoma.

In industrialized countries, glaucoma is the leading cause of blindness⁵.

• Risk factors

The principal risk factor of glaucoma is an increase in eye pressure, especially if it exceeds 21mmHg. However, excessive eye pressure does not necessarily indicate that glaucoma is present.⁶ Ethnicity may also be a risk factor, as glaucoma seems to be more prevalent in African Americans than in Caucasians.⁷ Also, the frequency of glaucoma increases with age and myopia, and reduced visual acuity.⁸

Circumstances likely to lead to an increase in eye pressure, such as trauma to the eye, inflammation of the eye or eye infections, may precipitate the occurrence of glaucoma.⁹ Eye surgery, for instance corneal grafts or complex retinal interventions, may also trigger the development of glaucoma.⁹

• Symptoms

Chronic open-angle glaucoma is asymptomatic in early stages, causing neither pain nor redness nor vision loss. This can be dangerous, as you may not notice that anything is wrong with your eyes, even as your field of vision degrades. Initially, the peripheral vision is damaged. In more advanced stages, both near vision and distance vision are also affected.¹⁰

Contrarily, acute angle-closure glaucoma develops quickly, and is in fact a medical emergency. Patients experience acute attacks during which the eye becomes red and painful. Nausea and vomiting may also be present. Patients often see rainbow haloes around lights, flashes of light or black spots and their vision may be blurred. In the absence of proper treatment, blindness may ensue.

► Diagnosis

As chronic glaucoma is initially asymptomatic, early detection is of paramount importance in the effort to minimise irreversible damage to the eye.

Diagnosis is based upon a thorough examination of the optic nerve with a special microscope called a slit lamp, and an evaluation of eye pressure with a tonometer. Recently, it has been shown that intraocular pressure has to be correlated with corneal thickness measurements. The thicker the cornea, the higher intraocular pressure may be, and vice versa. Corneal thickness is usually measured using pachymetry.

If the ophthalmologist deems it necessary, each eye's field of vision may be measured with a computer test. Alternatively, an Ultrasound of the optic nerve may be performed.

Very-high-frequency Ultrasound (more than 20MHz) is an examination that permits visualisation of the angle between the iris and the cornea. This angle allows us to specify the type of glaucoma (open-angle or angle-closure) and treat the patient accordingly. Additionally, very-high-frequency Ultrasound is the sole technique that permits visualisation of the structures behind the iris. Based on these images, the ophthalmologist can better understand the disease's underlying mechanisms and causes.

The examinations should be repeated in regular intervals. After the age of 40, glaucoma screenings should be scheduled annually or even more frequently if risk factors such as elevated intraocular pressure, family history of glaucoma, or marked myopia are present.¹¹

► Examinations

Measure of intraocular pressure

After applying an anaesthetic eye drop, the ophthalmologist is able to measure intraocular pressure with an instrument called a tonometer. This flattened instrument is applied to the cornea and is pushed lightly until the cornea becomes flat in the centre. The pressure that is necessary to flatten the cornea corresponds to the pressure inside your eye. This measurement may also be taken using a puff of air, a completely painless procedure not necessitating the application of anaesthetic eye drops.

In order to ensure that measurements of intraocular pressure are accurate when the cornea is too thin or thick, the ophthalmologist may perform pachymetry. This examination is performed with an ultrasonic pachymeter or an Orbscan pachymeter. If your ophthalmologist employs an ultrasonic pachymeter, he will gently touch your eye with an ultrasonic catheter. If he uses the more recently developed Orbscan pachymeter, which is able to take measurements without touching the cornea, no direct eye contact is necessary. The examination lasts only a few minutes and is painless.

Ophthalmoscopy

This examination, which is painless and devoid of risk, is indispensable for the evaluation of the optic nerve and the retina. After applying a few eye drops for pupil dilation, the ophthalmologist lightly applies a cone to the eye.

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This cone allows the doctor to examine with precision the interior of the eye and measure the angle between the cornea and the iris.

Because the eye drops may temporarily alter your vision, you are advised not to drive immediately after the examination.¹²

Estimation of the iridocorneal angle

In order to visualise the angle between the iris and the cornea and determine the type of glaucoma, the ophthalmologist may conduct ultrasound biomicroscopy (UBM), also called high-frequency ultrasound. To this end, he uses an ultrasound device with a transmitter emitting a sound wave of 50MHz or 25 MHz. This device permits a significantly more precise visualisation. In addition, today, high-frequency ultrasound scan is the only technique available to visualize the structures located just behind the iris. The visualization of these structures makes it possible to better estimate mechanisms and causes of glaucoma. UBM is also employed to follow up the effects of surgical interventions on the eye.

From a practical perspective, you are laying on your back. The ophthalmologist applies an anaesthetic to your eye and then places a cup between your inferior and superior eyelids in order to keep your eye open. Next, he applies a gel to the cup to assure quality contact between your eye and the transmitter. Following this, the ophthalmologist can easily move the transmitter around in the gel and view images of your eye's various structures on a display screen. This examination is not painful, as the transmitter is not in direct contact with your eye, but rather remains in the gel at a distance of several millimeters.

Progression and complications

If proper treatment is not administered, glaucoma causes progressive and irreversible degradation of the field of vision, which may lead to blindness. If you have undergone surgery or laser treatment, regular follow-up is essential. The effects of intervention may wane with time, leading to a new increase in intraocular pressure. In this case, a new medical or surgical treatment must be implemented. For this reason, regular visits to your ophthalmologist are of paramount importance. The interval of your visits may be left to your ophthalmologist's discretion, but examinations are generally recommended every 6 months.¹³

Treatment

Chronic glaucoma

Drug treatment

Although chronic glaucoma is not curable, it is regularly controlled thanks to efficacious medications. Regardless of whether or not you experience symptoms, once you have been diagnosed with glaucoma, administration of medications may become necessary in order to reduce eye pressure and prevent irreversible damage to the optic nerve¹.

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Several drugs are available to alleviate symptoms. They are generally administered as eye drops to be applied once to three times each day.¹⁴ The most frequently used eye drops contain prostaglandins, beta-blockers, or alpha-adrenergic agonists.¹⁵ The mechanism of action of these compounds differs. They act either by decreasing the production of fluid within the eye or by increasing drainage from the eye. They aim to maintain pressure levels that pose no danger to the optic nerve. Because glaucoma is not curable, the treatment must be continued indefinitely.

It may be useful to combine eye drops with different mechanisms of action. For example, one which serves to decrease intraocular liquid and one which aids drainage of this liquid may cooperate for a complementary effect. Certain drugs also exist in tablet form; however, as tablets are less well-tolerated, they are not prescribed as frequently.¹⁶

• **Surgical treatment**

The **trabeculectomy**, the oldest procedure, involves the removal of the trabeculum, which is responsible for the filtration of aqueous fluid. This procedure allows the evacuation of the intraocular fluid, thus decreasing eye pressure. During the operation, the surgeon opens the eye, removes the trabeculum, and then closes the eye with a few stitches.¹⁷

This technique is usually well tolerated. After the operation, small blebs, or bubbles may develop under the upper eyelid. This is a normal result of the drainage of a liquid reservoir from the eye¹⁶. After the intervention, patients may complain of ocular discomfort, tearing, and in some cases, real pain. Local care in the form of eye drops and anti-inflammatory ointments is administered in order to alleviate the inflammatory reaction due to the manipulation of the eye.

The **sclerotomy**, a more recent and precise technique, consists of removing only part of the trabeculum.¹⁶ As the eye is not opened during the procedure, recovery is more rapid. Contrarily to the trabeculectomy, the sclerotomy is not appropriate for all types of glaucoma.

• **Laser treatment**

Two techniques are currently available: Argon laser trabeculoplasty (ALT) and selective laser trabeculoplasty (SLT), a more recent technique. ALT is used less and less frequently in lieu of SLT, for reasons easy to understand. SLT delivers 100 times less power into the eye, thus, it is painless and significantly reduces risk of complications.¹⁸

During the SLT procedure, a hundred laser impacts are selectively focused on pigmented cells of the trabeculum, what increases its permeability. SLT is known as a “cold” laser, i.e. it does no thermal damage. The treatment is done in only one session. This procedure is not appropriate for all glaucoma patients, so your ophthalmologist is the best judge of which treatment method is right for you.

In certain chronic glaucoma cases, laser iridotomy is performed preventively to avoid progression to a complete angle closure.¹⁹

Acute glaucoma

Acute glaucoma is a medical emergency. If proper treatment is not administered within 2-3 days, vision may be irreversibly affected¹.

- **Laser treatment**

Although the drugs can usually decrease the intraocular pressure, surgical intervention, consisting of **laser iridotomy**, is most often necessary¹.

During this intervention, the surgeon creates a small incision in the iris, which permits evacuation of intraocular fluid. The procedure is habitually carried out under local anaesthesia. Due to its short duration, the iridotomy procedure can be performed on outpatients and is thus more popular than other available procedures. If this procedure is performed within 24 hours of the beginning of the attack, it is likely to be successful¹.

- **Surgical treatment**

The first surgical technique to consider is iridectomy. It consists in removing a part of the iris in order to make aqueous humor draining easier.

If iridectomy does not work, trabeculectomy could be performed.

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