



## Magnetic Therapy of Glaucoma

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### Glaucoma, Causes, Symptoms, Possible Treatments

Glaucoma is a common eye condition in which the optic nerve, which connects the eye to the brain, becomes damaged. It is usually caused by fluid building up in the front art of the eye, which increases the pressure inside the eye. Glaucoma can lead to a loss of vision, if it is not diagnosed and treated early.

It can affect people of all ages, but it is most common in adults in the 70s and 80s.

#### Symptoms of glaucoma

There is one type of glaucoma, which develops gradually over many years, it affects the edges of the eyes (peripheral vision) first. It generates a blurred vision, seeing rainbow colored circles around bright lights.

Both eyes are usually affected, although it may be that it is worse for one eye.

Very occasionally, glaucoma can develop suddenly and can cause intense eye pain, nausea and vomiting, a red eye, headache, tenderness around the eyes, seeing rings around lights, blurred vision. Without treatment a glaucoma can eventually lead to blindness.

#### Different types of glaucoma

Most common is the primary open glaucoma. This develops gradually over many years; I am caused by a drainage stopping in the eye becoming gradually clogged over time.

Other types, are acute angle closure glaucoma, which is an uncommon type caused by the drainage in the eye becoming suddenly blocked, which can raise the pressure in the eye very quickly.

Secondary glaucoma caused by an underlying eye condition, such as an inflammation in the eye.

Childhood glaucoma, a type which occurs in very children, caused by an abnormality of the eyes.

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Glaucoma can appear for a number of reasons. Most cases are caused by a buildup of pressure in the eye when fluid is unable to flow out. This increases the pressure, which damages the nerve that connects the eye to the brain (optic nerve).

#### Risk factors

Age increased risk for older people. Ethnicity, Africans, Caribbean's, or Asians have a higher chance to get a glaucoma.

Family history, one is more likely to develop a glaucoma when one has a parent or sibling with this condition.

Other medical conditions, such as short-sightedness, long-sightedness and diabetes.

#### Possible treatments

Eye drops, to reduce the pressure within the eye.

Laser treatment, to open the blocked drainage tubes or reduce the production of fluids in the eyes.

Surgery, to improve drainage of the eyes. A tiny pliable tube injection into the eyes allows excess fluid to drain out and to relief pressure. The injection of a compound in the eye (which helps to reduce the eye pressure) by a microneedle, ranging in length from 400 microns to 700 microns, provides a new way to deliver drugs in special areas in the eye. By targeting the drugs only to special parts of the eye, the researchers hope to increase the effectiveness.

It is discussed that even a low-grade inflammation is a causing factor in the pathogenesis of glaucoma [1,2]. There are treatments by medical drugs, which however may have unwanted by side

effects [3]. A pulsed electromagnetic field treatment of Glaucoma has been suggested [4,5].

## Electromagnetic Therapy of Glaucoma

I now describe the magnetic therapy and explain the physical processes underlying this therapy. The basis of this therapy is the fact that even a low-grade inflammation has a causing function for the pathogenesis of a glaucoma disease [1,2]. Inflammations can be cure by oxygen particles which are in the blood. When applying a time-oscillating electromagnetic field (An electromagnetic wave is generated in the tissue [4,5]). An electromagnetic wave is described by

$$E = E_0 \cos(\omega t - k r), \quad (1)$$

$$B = B_0 \cos(\omega t - k r). \quad (2)$$

Here  $E$  is the electric part of the electromagnetic wave, and  $B$  is the magnetic part, with the magnetic induction

$$B = H + 4\pi M, \quad (3)$$

with the magnetic field  $H$  and the magnetization  $M$ . In equations 1 and 2 the quantity  $\omega$  is the angular frequency of the electromagnetic wave, and the vector  $q$  is its wave vector. An electromagnetic wave carries energy, and part of this energy is absorbed in the tissue, generating a certain amount of warming up the tissue. When the blood vessels are warmed up, then their diameters increase and the blood flow increase. As a result the oxygen particles in the blood which are required to cure inflammations come more rapidly and more frequently to the sites of inflammations, and this helps to remove the inflammations which have causing functions for the pathogenesis of the glaucoma [1,2].

Furthermore, in the blood are particles with charge  $q$ , mainly  $\text{Ca}^{2+}$  ions and other ions with positive and negative charge, respectively. The electromagnetic wave exerts Lorentz forces  $F$  on the ions,

$$F = q(E + v \times B). \quad (4)$$

Here  $v$  is the velocity of the ions in the blood, and the symbol  $\times$  in the second part of equation 4 denotes the vector product. When the electric field is applied in a direction perpendicular to the direction of the blood flow, then the Lorentz forces accelerate the ions in directions perpendicular to the blood flow and give them more energy. The ions hit the walls of the blood vessels, and in each hit they transfer at least part of their energy to the blood vessels. This generates a certain amount of warming up the blood vessels. When the blood vessels are warmed up, then their diameters increase and the blood flow increases. As a result the oxygen particles in the blood which are required to cure inflammations come more rapidly and more

frequently to the sites of inflammations, and this helps to remove the inflammations, which have causing functions for the pathogenesis of the glaucoma.

I want to note that Lorentz forces do not appear only when applying a time-oscillating electromagnetic field [4,5], but also when applying a static electric and/or electric field. This means that an electromagnetic field therapy of glaucoma cannot be performed only by applying time-oscillation electromagnetic fields but also by applying static electromagnetic fields, which is often more simple than applying time-oscillating electromagnetic fields.

## Conclusion

In my paper I have described causes, symptoms and possible treatments of a glaucoma. There are treatments by surgery or by medical drugs, which however may have unwanted bad side effects [3]. An electromagnetic field treatment has been first suggested [4,5]. The basis of this therapy is the fact that inflammations have causing functions for the pathogenesis of a glaucoma Inflammations [1,2]. By the magnetic therapy the oxygen particles in the blood which are required to cure inflammations come more rapidly and more frequently to the sites of inflammations, and this helps to remove the bad inflammations.

This is a very interesting example for the electromagnetic field treatment of a human disease. Electromagnetic fields treatments are used for many other diseases, for instance, the pulsed electromagnetic field treatment of cancer [6].

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