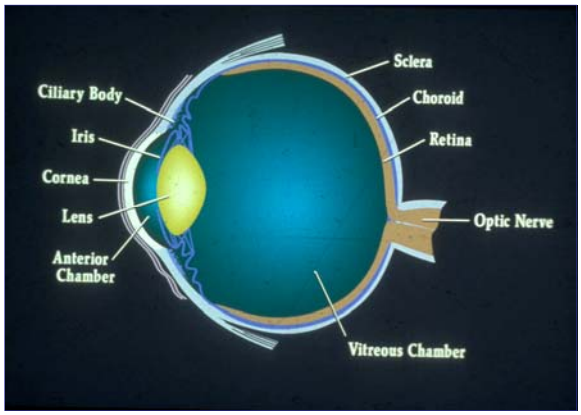
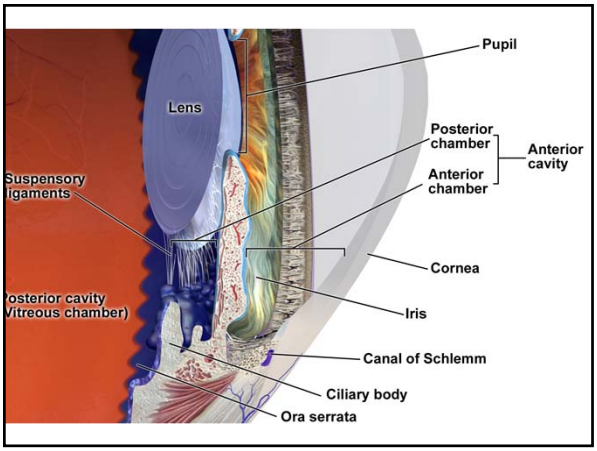
Glaucoma

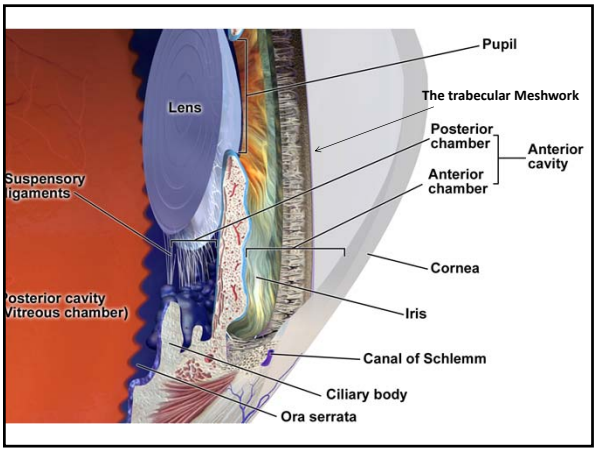
Ted W. Reid, Ph.D.





Ciliary Body

- Produces fluid that is pumped into the eye
- This fluid is important in maintaining the pressure of the eye.
- The pressure of a normal eye is 16mm Hg.

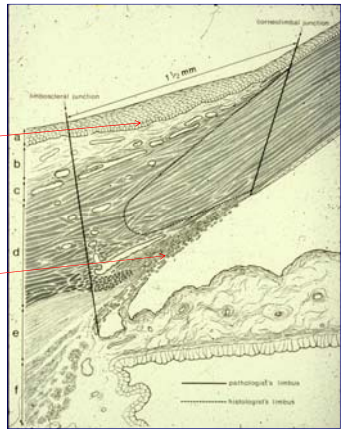


The Limbus - Trabecular Meshwork

Corneal Limbus

Site of Epithelial Stem Cells

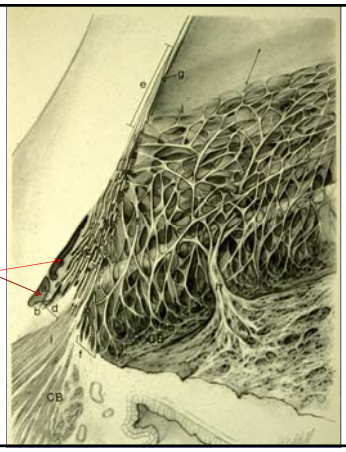
Aqueous outflow



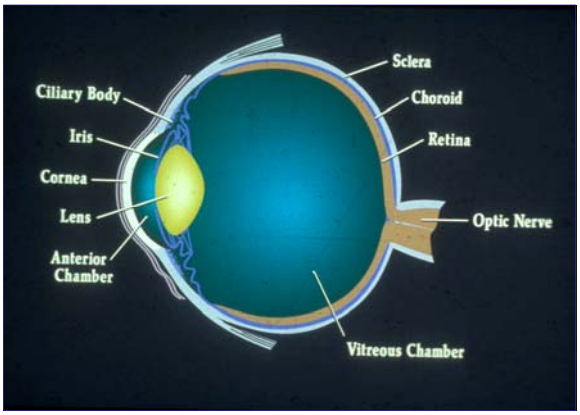
Trabecular Meshwork

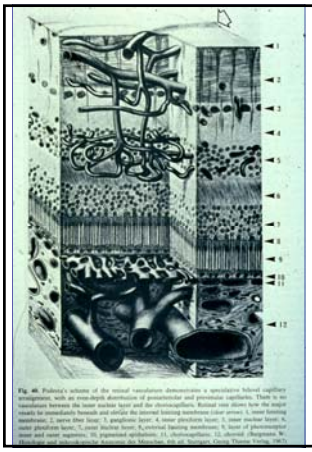
Outflow channels for aqueous humor

Schlemms Canal



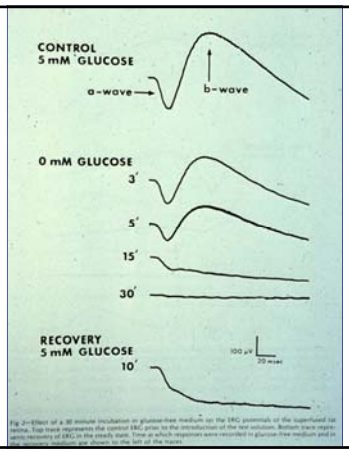
The Retina





Note the extensive vasculature of the retina.

The retina has 5 times the oxygen Content of any other tissue in the body



ERG

Effect of 30 minutes of glucose free medium for the superfused rat retina

What is glaucoma

What is glaucoma

- A disease of the eye which causes a gradual degeneration of retinal ganglion cells (cells going to the brain)

What is glaucoma

- A disease of the eye which causes a gradual degeneration of retinal ganglion cells (cells going to the brain)
- A disease where the primary risk factor is an increase in pressure of the eye

What is glaucoma

- A disease of the eye which causes a gradual degeneration of retinal ganglion cells (cells going to the brain)
- A disease where the primary risk factor is an increase in pressure of the eye
- A disease that is treated with drugs that lower eye pressure

What is glaucoma

- A disease of the eye which causes a gradual degeneration of retinal ganglion cells (cells going to the brain)
- A disease where the primary risk factor is an increase in pressure of the eye
- A disease that is treated with drugs that lower eye pressure
- A disease that is treated with surgery to lower eye pressure

What is glaucoma

- A disease of the eye which causes a gradual degeneration of retinal ganglion cells (cells going to the brain)
- A disease where the primary risk factor is an increase in pressure of the eye
- A disease that is treated with drugs that lower eye pressure
- A disease that is treated with surgery to lower eye pressure
- A disease that is one of the leading causes of blindness

How does Glaucoma cause blindness

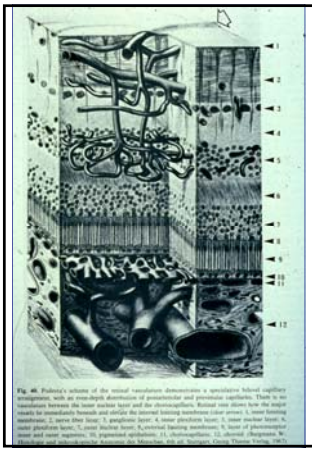
- Current thinking is that the pressure causes glaucoma

How does Glaucoma cause blindness

- Current thinking is that the pressure causes glaucoma
- How does the pressure cause glaucoma?

How does Glaucoma cause blindness

- Current thinking is that the pressure causes glaucoma
- How does the pressure cause glaucoma
- It restricts the blood flow to the retina



Note the extensive vasculature of the retina.

The retina has 5 times the oxygen Content of any other tissue in the body

How does Glaucoma cause blindness

- Current thinking is that the pressure causes glaucoma
- How does the pressure cause glaucoma
- It restricts the blood flow to the retina
- Is this the whole story?

Old Results

- Some people with no increase in pressure experience the same destruction to their retina.
- Progressive loss of nerve cells can continue in patients whose IOP is controlled.

High IOP a Stress Factor

- Stress is known to trigger autoimmune responses.

High IOP a Stress Factor

- Stress is known to trigger autoimmune responses.
- What is autoimmune – it is when our antibodies start to react with our own body.

High IOP a Stress Factor

- Stress is known to trigger autoimmune responses.
- What is autoimmune – it is when our antibodies start to react with our own body.
- In patients with glaucoma they find antibodies against their own heat shock proteins

What is a heat shock protein?

- It is a family of proteins in our body.

What is a heat shock protein?

- It is a family of proteins in our body.
- They are made in cells under different kinds of stress (heat, cold, UV light and wound healing).

What is a heat shock protein?

- It is a family of proteins in our body.
- They are made in cells under different kinds of stress (heat, cold, UV light and wound healing).
- They help to heal proteins damaged by stress.

What is a heat shock protein?

- It is a family of proteins in our body.
- They are made in cells under different kinds of stress (heat, cold, UV light and wound healing).
- They help to heal proteins damaged by stress.
- They are found in all species – even bacteria.

Authors Hypothesis

- High pressure somehow produces antibodies to heat shock proteins (HSP)

Authors Hypothesis

- High pressure somehow produces antibodies to heat shock proteins (HSP)
- Human glaucoma patients are found to have antibodies to their HSP

Authors Hypothesis

- High pressure somehow produces antibodies to heat shock proteins (HSP)
- Human glaucoma patients are found to have antibodies to their HSP
- These antibodies are also against HSP from bacteria.

Authors Hypothesis

- High pressure somehow produces antibodies to heat shock proteins (HSP)
- Human glaucoma patients are found to have antibodies to their HSP
- These antibodies are also against HSP from bacteria.
- These antibodies start to attack the patient's own HSP

Where do these antibodies come from

- HSP from bacteria are very similar to our HSP

Where do these antibodies come from

- HSP from bacteria are very similar to our HSP
- The antibodies may have been produced in the past against bacteria in our body.

Where do these antibodies come from

- HSP from bacteria are very similar to our HSP
- The antibodies may have been produced in the past against bacteria in our body.
- IOP stress produces HSP in our eye.

Where do these antibodies come from

- HSP from bacteria are very similar to our HSP
- The antibodies may have been produced in the past against bacteria in our body.
- IOP stress produces HSP in our eye.
- The IOP also damages the blood retinal barrier

Where do these antibodies come from

- HSP from bacteria are very similar to our HSP
- The antibodies may have been produced in the past against bacteria in our body.
- IOP stress produces HSP in our eye.
- The IOP also damages the blood retinal barrier
- This allows the antibodies to the bacteria to get into the eye.

Where do these antibodies come from

- HSP from bacteria are very similar to our HSP
- The antibodies may have been produced in the past against bacteria in our body.
- IOP stress produces HSP in our eye.
- The IOP also damages the blood retinal barrier
- This allows the antibodies to the bacteria to get into the eye.
- The antibodies interact with T-cells

The authors also showed:

- High IOP allowed T-cells to penetrate the blood-retinal barrier

The authors also showed:

- High IOP allowed T-cells to penetrate the blood-retinal barrier
- Inducing high IOP in mice with no T-cells showed little damage and no progression of disease after pressure was returned to normal.

Take Home Message

- Probably the role of the increased pressure in the eye is to cause damage to the tight junctions of the retina.
- Damage allows the immune molecules to enter the retina.
- These immune molecules can attach molecules in the retina that are similar to those found on bacteria.
- This causes a slow destruction of the retina.

Take Home Message

- New treatments should be focused on this immune response.