Age-related Disorders of the Eye: Cataracts, Presbyopia (Age-related farsightedness), Hypertensive Retinopathy and Vitreous Degeneration

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This article examines aging and age-related disorders of the retina, lens, and vitreous body. Hypertensive retinopathy is a condition that is characterized by retinal vascular changes in people with elevated blood pressure. The screening, detection, and documentation of hypertensive retinopathy in patients with established hypertension is currently considered as standard management in the care of patients with high blood pressure.

Overview

Aging is associated with vitreous degeneration. The most common age-related disorders of the lens include:

- Cataracts
- Posterior capsular calcification
- Presbyopia

Hypertensive Retinopathy

Pathophysiology of Hypertensive Retinopathy

Patients with elevated blood pressure develop **pathophysiological changes in the retinal circulation.** In the initial stages, vasoconstrictive changes predominate. In cases of acute elevation of blood pressure, reversible vasoconstriction occurs in blood vessels. There is increased narrowing of the retinal arterioles due to arteriolar wall spasm. If there is persistent hypertension or severe hypertension, the retinal blood vessels become thickened and hyperplasia of the media wall can develop, with exudative vascular changes and necrosed and damaged endothelium. Hyaline degeneration is also often seen.

Hypertensive retinopathy can progress to an exudative stage with:

- Disruption of the blood-retinal barrier
- Necrosis of the smooth muscles
- Exudation of blood and lipids
- Retinal ischemia

Retinal microaneurysms, hemorrhages, and hard exudates are seen at this stage. Cotton wool spots are developed due to retinal ischemia as a secondary result of necrosis and narrowing of retinal arterioles.

Patients with malignant hypertension may develop swelling of the optic disc, especially in a hypertensive crisis. When diabetes develops with hypertension, there is an increased risk of loss of vision. Hypertensive retinopathy can also lead to hypertensive damage to other target organs.

Epidemiology of Hypertensive Retinopathy

Because the detection and identification of hypertensive retinopathy are currently a simple procedure, **accurate epidemiological studies** have emerged to study the prevalence of the condition. Hypertensive retinopathy is more common in people aged 40 years or older, regardless of a history of hypertension.

The prevalence of hypertensive retinopathy in this age group is estimated to range from 2% to 15%, making it a common finding on fundus photography. African Americans have a higher risk of hypertensive retinopathy, most likely due to the more aggressive forms of hypertension seen in this population.

There is a similar prevalence of hypertensive retinopathy in both men and women. The incidence of hypertensive retinopathy over a 5-year duration is approximately 10% in people with high blood pressure. The main risk factor for hypertensive retinopathy is hypertension.

The presence of a positive family history of high blood pressure and involvement of target organs increase the incidence of retinopathy. The presence of hypertensive retinopathy in a person without a history of hypertension is a marker of a prehypertensive state. The severity or mere presence of hypertensive retinopathy is strongly associated with the risk stratification of stroke in hypertensive patients. The risk of coronary heart disease in hypertensive patients can be also estimated from the degree of retinopathy.

Classification of Hypertensive Retinopathy

The current classification of hypertensive retinopathy takes into account the severity of retinopathy and the possible systemic risk associations with each grade.

The following table summarizes the classification of hypertensive retinopathy.

Grade of Retinopathy	Retinal Findings	Systemic Risks
None	None	• Small risk of stroke • Subclinical stroke • Coronary heart disease • None
Mild	• Generalized arteriolar narrowing • Focal arteriolar narrowing • Arteriovenous nicking • Copper wiring	• Small risk of stroke • Subclinical stroke • Coronary heart disease
Moderate	• Retinal hemorrhage in the shape of flames, dots, or blots • Exaggeration of arterial light reflex • Microaneurysms, cotton-wool spots, or hard exudates	• Clinical stroke • Cognitive decline • Retinal dysfunction • Death from cardiovascular disease • Cerebral dysfunction
Malignant	The same findings of moderate retinopathy plus optic disc swelling and Elschning's spots	• Severe cerebral, cardiac or renal dysfunction • Strong association with sudden death

Treatment of Hypertensive Retinopathy

Regression of hypertensive retinopathy has been reported in patients who regain control over their elevated blood pressure. Therefore, it is currently recommended to **provide better control of blood pressure** with changes in lifestyle in patients with hypertensive retinopathy before offering any retinal-specific treatments. Surgery is recommended in some cases of secondary causes of hypertension.

Cataracts

Clear vision tends to start to deteriorate after the third decade of life due to the loss of the transparency of the lens. This condition is caused by the development of cataracts. Cataracts are **caused by the aggregation of crystallin proteins in the fiber cells of the lens.** Because cataracts are an aggregation disease, it is easy to see why aging is the main risk factor.

High concentrations of crystallin proteins in the lens can lead to abnormal refraction and are responsible for the visual impairment seen in patients with cataracts. Because the lens fiber cells do not have any intracellular organelles, they are unable to clear out or fix the aggregated crystallin proteins.

One in every 5 individuals aged 65 to 74 years tends to develop cataracts, and 1 in 2 individuals older than 75 years develops a cataract. Senile cataracts tend to decrease vision and, if left untreated can, in time, lead to blindness. Cataracts are the most common cause of treatable blindness in the developed world.

Either or both eyes can develop a cataract; however, a cataract does not spread from one eye to the other.

Clinical Presentation of Cataracts

A patient with cataracts presents with the following clinical signs:

- Decreased visual acuity
- Glare (a decrease in contrast sensitivity in bright light)
- Myopic shift or worsening of myopia
- Monocular diplopia
- Blurred vision
- Poor night vision
- Double vision or multiple images
- Reduced perception of colors

Diagnostic Workup for Cataracts

An ocular examination is warranted and must include tests for **visual acuity for near and far distances**. If the patient also complains of glare, visual acuity needs to be tested in a brightly lit room. A swinging flashlight test can detect a Marcus Gunn pupil due to relative afferent pupillary defect. This test is useful in differentiating cataracts from optic nerve lesions as the potential cause of decreased visual acuity.

Cataracts can be diagnosed by dilating the pupils using drops and observing changes with magnifying glasses. Tonometry is also used to measure pressure in the eyes by using drops to create numbness.

Prior to phacoemulsification surgery, cataract density had to be determined by an examination of the nuclear size and brunescence.

Image : “An example of normal vision on the left versus vision with cataracts on the right” by National Eye Institute. License: Public Domain

Image : “Eye disease simulation, cataract.jpg” by National Eye Institute. License: Public Domain

Treatment of Cataracts

Lens extraction is the definitive treatment for cataracts. **The three most commonly used surgical approaches for lens extraction in current practice are:**

- Intracapsular cataract extraction—for removal of the entire lens affected by a cataract
- Extracapsular cataract extraction—for removal of advanced cataracts
- Phacoemulsification—for dissolving lens fragments that develop a cataract

An intraocular lens implantation procedure is commonly used after lens extraction for the restoration of normal visual acuity. Intraocular lens implantation is easier when an extracapsular cataract extraction or phacoemulsification approach is used.

Posterior Capsular Opacification

After the surgeon removes cataracts with phacoemulsification, there is usually a thin layer of lens epithelial cells left adherent to the inside of the capsular bag. These cells tend to proliferate with time and form an opacification behind the capsule, causing impairment in visual acuity.

Exposing the eye to light emitted from a **neodymium-doped yttrium aluminum garnet laser** can solve this problem. Unfortunately, this treatment option should not be used in patients with retinal disease to treat posterior capsular opacification because of the risk of retinal detachment and retinal edema.

Presbyopia

As we age, the lens loses its ability to focus on near objects. Almost all middle-aged individuals will develop presbyopia. **The pliability of the lens plays an important factor** in allowing the lens to change shape in response to focusing on near objects. Pliability is reduced as aging proceeds. Lens stiffness usually begins to become symptomatic in the third to fifth decades of life.

The definitive treatment for presbyopia involves replacing the stiff lens with an intraocular lens with accommodation properties. Unfortunately, a perfect accommodative lens without visual defects is yet to be developed. Therefore, the currently acceptable treatment of presbyopia is to use a reading glass for near objects.

Vitreous Degeneration

Over time, the vitreous gel in the posterior compartment of the eye tends to collapse. This is related to senile degradation of the collagen fiber network of the vitreous body. Patients with degenerative changes of the vitreous body may develop a retinal detachment.

The treatment of vitreous degeneration includes vitrectomy followed by replacement of the vitreous gel with a balanced salt solution.

References

The New England Journal of Medicine:
http://www.nejm.org/doi/full/10.1056/NEJMra032865

Petrash JM. Aging and Age-Related Diseases of the Ocular Lens and Vitreous Body. *Investigative Ophthalmology & Visual Science*. 2013;54(14):ORSF54-ORSF59. doi:10.1167/iovs.13-12940.

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