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Vision-reducing Cataracts Can Be Counteracted Through Precautions and Surgery

Cataracts cloud the eyes' lenses and can cause a number of symptoms that degrade vision. Although precautions can reduce the likelihood of developing cataracts or delay their onset, there is no absolute means of prevention. But even fully developed cataracts can be overcome by a relatively simple surgical procedure.

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The lens of the human eye (Figure 1, page 2) focuses light onto the retina, the tissue at the back of the eyeball that transmits nerve impulses to the brain, where they are interpreted as a visual image. When the lens becomes clouded, losing its original transparency, vision is diminished — a disorder called a cataract. That the word "cataract" also means a waterfall is not accidental; it was once believed that some opaque material flowed, like a waterfall, down into the eye.

Actually, cataracts result from changes in the cell-protein structure of the lens. The lens is constructed of living transparent "crystalline tissue" semicolumnar cells. Any physical or chemical mechanism that interrupts the metabolic life processes that maintain transparency within these cells will impair light transmission. The disruption of protein structure is called "denaturation." Heating a transparent egg white will result in coagulation of the protein in the egg white and its subsequent opacity; similarly, excess heat, radiation or kinetic energy applied to the lens of the eye will change the protein, with a loss of transparency.

Cataract symptoms include:

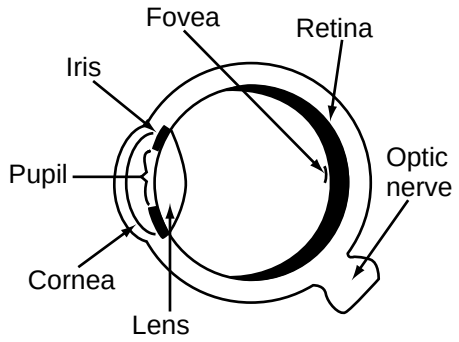
- Blurry or foggy vision;
- Loss of color-perception acuity, with colors appearing "washed out";
- Glare or excess brightness — for example, automobile headlights that are uncomfortably intense at night;
- Double vision;
- Halos around objects;
- A need for more light to read or see clearly; and,
- Various other vision problems.

Cataracts are the leading cause of vision loss worldwide.[1]

The vast majority of cataracts develop very slowly.[2] Some (cortical cataracts) begin in the outer perimeter of the lens and do not cause visual impairment until they eventually begin to close in on the central portion of the lens. Others (nuclear cataracts) begin in the central part of the lens and impair vision early in their formation. A decrease in visual acuity, even with the best refraction (vision correction through artificial lenses), is a possible symptom of a developing central lens cataract. An eye specialist, using standard optical viewing equipment, can detect this type of cataract.

Flight crewmembers can practice precautionary measures that minimize the development of cataracts. And, when cataracts first appear, they can be compensated for sometimes by a change

Schematic Diagram of the Human Eye



Source: Stanley R. Mohler, M.D.

Figure 1

in eyeglass prescription. After a cataract has become severe enough, however, surgery to replace the affected lens or lenses is the only treatment — but such surgery is a relatively minor operation, and is successful more than 90 percent of the time.

Most people who begin to develop cataracts have reached at least the age of 50, and more typically cataracts are diagnosed in those older than 60. Various factors appear to increase the likelihood of developing the disorder.

Occasionally, genetic factors are involved in cataract development. One example is galactosemia, an inheritable disorder that interferes with the metabolism of milk and milk products. If not treated, galactosemia also can result in cataracts.

Cigarette smoking has been shown to correlate directly with increased cataract formation.[3] Both Type I (insulin-dependent) and Type II (noninsulin-dependent) diabetes mellitus present a risk of cataract formation, unless the high blood-sugar levels that result from this disorder are controlled.

Exposure to high levels of ionizing radiation that occur around industrial sources such as the x-rays used in nondestructive testing at maintenance facilities, and high levels of industrial microwave radiation, which occur at radar sites, can be cataract hazards unless protective measures are in place. (The U.S. Occupational Safety and Health Administration, the U.S. Federal Aviation Administration and other civil aviation authorities have established safety requirements for maintenance and radar sites to guard against radiation hazards.)

The intense light energies produced by welding equipment have been associated with cataract formation if there is inadequate eye protection.

Certain sports have a significant risk of producing physical injuries to the eye, including the lens. A frequent complication of this type of injury is a traumatic cataract, which can develop within hours. For example, direct injury to the eye by a baseball can be a major hazard. An accidental penetration of the eye by a handgun pellet, a fragment of a bullet or a dart is very likely to produce a cataract.

Exposure of the unprotected eye to intense sunlight has been correlated with an increased prevalence of cataracts. Some cataract formation appears to result from part of the ultraviolet (UV) spectrum in sunlight. Evidence for this was gathered by medical researchers in a study of Chesapeake Bay watermen.[4]

Study participants were residents of two counties in the state of Maryland, U.S., who had worked at occupations associated with the nearby Chesapeake Bay. The participants were selected because they were a stable occupational group whose long-term occupational practices, and therefore their exposure to UV radiation in sunlight, could be determined.

"The annual ocular exposure [for the 838 watermen participants] was calculated from the age of 16 for each waterman by combining a detailed occupational history with laboratory and field measurements of sun exposure," said Taylor and colleagues, the researchers. "Cataracts were graded by ophthalmologic examination for both type and severity."

Cortical cataracts were found in 111 participants (13 percent), and nuclear cataracts were found in 229 participants (27 percent).

"In this study … we found a clear association between the degree of ultraviolet B [UVB] exposure and the risk of cortical cataracts," said Taylor and colleagues.

[UVB is one of three defined bands in the ultraviolet part of the sunlight spectrum, with wavelengths of 320 nanometers to 290 nanometers. In addition to its correlation with cortical cataracts, UVB has been found to be a causal factor in sunburn and skin cancer.]

"Although we found a strong association between [UVB] exposure and cortical cataracts, we did not find nuclear cataracts to be associated with [UVB] exposure," said Taylor and colleagues. "This does not necessarily mean that [UVB] exposure plays no part in the induction of nuclear cataracts, but if an association exists, it would seem to be much weaker than that for cortical cataracts."

A more recent study,[5] the Salisbury Eye Evaluation Project, by West and colleagues, gathered and analyzed data about the relationship between sunlight and cataracts in a more varied population, and one that would be likely to have lower levels of UVB exposure than the Chesapeake Bay watermen. The Salisbury Eye Evaluation Project included 2,520 participants between ages 65 and 84. Fifty-eight percent of the participants were women and about one-fourth were African Americans.

"This study has found a significant association between cortical opacity with even the lower levels of ocular UVB exposure likely to be found in the general population of older persons," said West and colleagues.

Prevention and treatment of cataracts by flight crewmembers consists of "primary prevention," "secondary prevention" and "tertiary prevention."

Primary prevention consists of actions that a flight crewmember can take to prevent the trigger mechanisms that are known to lead to cataract formation.

Taylor and colleagues recommended shielding the eyes from unnecessary exposure to UVB.

"The amount of ambient [UVB] varies markedly during the day (it is highest in summer between 10 a.m. and 2 p.m.)," said Taylor and colleagues. They recommended wearing a hat with a brim, which can reduce UVB exposure by half.

A UV-protective coating is available for eyeglass lenses, and the coating can reduce UVB exposure to 5 percent of that in ambient sunlight. The coating is available on both clear glasses and sunglasses. To inhibit cataract formation, sunglasses must have the UV-protective coating; mere darkness is not effective.

UVB exposure is only one factor that can lead to development of cataracts, however, and other preventive measures are in order.

Eye protection by safety goggles, while using tools that can produce chips of metal, wood, plastic, glass or other materials, can prevent particles from penetrating the cornea and entering the lens. U.S. and most other countries' military pilots wear helmets with visors as a safeguard against eye injuries, including traumatic cataracts.

Avoidance of exposure of the eye to high-energy local heat and light sources (as occurs with glass blowers, who were noted long ago to be subject to "glass-blower" cataract, and with welders who use inadequate viewing protection) is important.

Type I diabetics who self-administer insulin to maintain optimal blood-sugar levels are also helping to protect themselves against cataracts. For Type II diabetics, careful control of blood sugar through diet and exercise is an important cataract-formation preventive. Individuals with this type of diabetes may use oral medication to assist in controlling their blood sugar. (The eye's lens contains no blood vessels, but absorbs nutrients through the fluid in front of the lens.)

Balanced nutrition is a preventive, including in the diet sufficient vitamins and minerals as cited in the recommended dietary allowances of The National Academy of Sciences' Food and Nutrient Board.

Secondary prevention involves periodic screening by an ophthalmologist or optometrist for evidence of cataract formation.

Should a cataract begin to develop at the outer margins of the lens, the eye specialist can view this initial process by use of a "slit lamp." The eye specialist dilates the pupil with drops of medication to create the widest pupillary field for studying the lens and the other interior structures of the eye, including the retina.

In the early stages of cataract development, a change in the patient's corrective-lens prescription can sometimes provide symptomatic improvement. As the cataract progresses, when it reduces vision below an acceptable level, "tertiary prevention" — removal of the cataract — becomes necessary to restore the light path to the retina.

Cataract surgery today uses technology that is far in advance of that commonly practiced even 30 years ago. The procedure is performed relatively quickly, and an artificial lens is implanted following the cataractous lens removal. The cloudiness and other cataract symptoms are eliminated, but — unlike the natural lens — the artificial lens cannot change its shape to help it focus. Refractive correction, for either near or distant vision, must be worn to compensate for the artificial lens's inflexibility.

Cataract surgery is today an outpatient procedure in almost all instances.[6] Many times the opaque lens can be removed and an implant placed properly within 20 minutes. Two procedures are available for removal of the lens. One, referred to as "phacoemulsification," is accomplished through an 0.08-inch to 0.2-inch (two-millimeter to five-millimeter) incision in the eye, and a tiny ultrasonic vibration device breaks up the lens proteins. These breakdown particles are then extracted, which results in the removal of the central hardened lens material. The remaining outer portion of the lens is removed, and the artificial lens is then slipped into place.

The second method involves making an incision and mechanically pulling the lens out of the eye with the immediate insertion of the artificial lens into the remaining empty lens capsule.

Commonly, the individual returns home the morning or the afternoon of the operation. In most of these procedures, a local anesthetic is used.

Following recovery and an assessment of visual acuity in accordance with aviator medical standards, individuals are routinely medically certified by the civil aviation authority in the class of medical certificate for which the applicant is qualified.

As in so many areas related to health, the flight crewmember can take some of the responsibility for preventing the premature onset of cataracts. This includes use of basic eye protection, periodic screening and healthy lifestyle choices.♦

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