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Review Article

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Eye Lens and Cataract Trends

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Abstract

In this paper we present facts on the ocular lens, and its loss of transparency, which after some time, is termed as cataract. We touch upon cataract caused by environmental toxins: mercury in particular, and some clinical physiology. Conclusive proof on steroid-induced cataract does not exist at the time of this writing. Trends on frequency of eye surgery by geographic region, and the tendency to wait upon first diagnosis-- or to remove the cataract urgently, are not meant to suggest it is unethical, instead, it is epidemiology.

Keywords: Steroid Induced, Lenticular Opacity, Iatrogenic Dysbiosis, Immunologic Barrier, Mercury Poisoning, Ocular Toxicology, Light-Scattering Vacuoles

1. Historical Discovery of Lens Anatomy

Having invented the light microscope, Antony van Leeuwenhoek examined rods and cones in the retina, and epithelium of the cornea [1]. The eye lens was shown to have a lamellar structure, layered like an onion, by Antoine Maıˆtre-Jean and Francois Pourfour du Petit, who also discovered the posterior chamber (space between the optically clear lens and the light-blocking pigmented iris) [2]. One quarter of a century elapsed, and in 1755, Johann Gottfried Zinn described the zonular fibers (named "ligaments of Zinn") connecting the outer lens capsule with ciliary processes [3].

2. Retinal Chromaticity Drives Muscle to Deform Lens

Polychromatic image blur of an attended object in front of the facial plane, can produce an eye focusing response to sharpen clarity at the retina [4]. This is known as "lens accommodation" and it is accomplished by forces transmitted from ciliary muscle to the outermost lens layer (capsule) by way of tension in the zonular fibers [5]. Such forces deform the internal lens, helping to attain focus of an image that suffers optical aberrations. Accurate accommodation requires certain spatial and chromatic properties within the target of interest, and if the object of attention does not have optimal size, contrast, and color, the eye tends to drift away or lag behind from the position of best focus [6-9].

3. Cataract Physiology from Age-Related Factors

Aside from its water content (65%), the lens is mostly protein, in fact more protein per unit volume, than ANY other tissue of the human body [10]. Loss of transparency starts with elevated calcium and sodium, and sub-normal concentration of potassium, glutathione, ascorbate molecular species, and reduced uptake of oxygen. This leads on to alignment disruption to oriented lens fibers, edema from water accumulation, and vacuole formation. It is believed that age-related cataract more often affects the "central" or "nuclear" region of the crystalline lens, and cataracts NOT from aging would likely be located outer to the nucleus [11,12].

4. Cataract and Corticosteroid Medication

Based on biochemistry and metabolic physiology, it seems likely that steroid eye-drops used many times each day, for longer than 5 weeks, could engender eye pressure elevation and cataract formation, but big data studies are presently inconclusive [13]. Dexamethasone eye-drops deployed after surgical removal of cataract, are absorbed systemically, and with long term use, there may be a decline in cortisol concentrations, with concomitant increase in blood levels, of adrenocorticotropic hormone (ACTH) [14].

5. Cataract Surgery on Children and Eye Patching

It is tragic that, in children and teenagers who are given systemic steroid therapy, the incidence of posterior sub-capsular cataract is high and this poses a great challenge to current medical practice and to the family members [15]. An eye patch to cover the operated eye (in persons of all ages) has been standard practice for more than a century, but a recent study seems to suggest that patching may not be the best strategy [16].

6. Toxic Metals (Mercury) And Cataract from Fission Isotopes

Cataract might also be precipitated from inhalation exposure and oral ingestion, of toxic heavy metals such as Hg/mercury, which

may inadvertently be found in grocery purchased seafood, such as fish harvested from waters contaminated with industrial effluents [17-31]. The fission energy reactor accident at Chernobyl, even outside of the region that felt the explosion, has been riddled many years with disease from exposure to decay-prone, unstable isotopes, producing cataract, leukemia, and birth defects [32].

7. Miscellaneous *Harmful Prescription Drugs

Psychotropic medication produces eye lens opacity of the "anterior capsule," and phenothiazine drugs are relatively safe when compared to other pharmaceutical agents [33]. Among drugs used long-term for managing chronically raised blood pressure/hypertension, perhaps it is only the alpha-glucosidase inhibitors that can sometimes produce lens opacity, and here the loss of optical transparency locates to the layers of lens just outer from the lens nucleus, and the diagnostic term is "cortical cataract [34]." Echothiophate iodide, a pupil constricting local agent to reduce eye pressure in glaucoma, can also disturb lens physiology. Di-nitro-phenol, the appetite suppressant from a hundred years ago, was probably much worse than are drugs of such nature, sold in the marketplace today.

8. "Democracy" Data on Cataract Surgery Trends

Surgery in democratic America to remove age-associated cataract, is performed in patients nearly 20 years younger in the State of Illinois compared with New York State [35]. Per capita, least numbers of such eye surgical procedure were performed in Honolulu, Hawaii, and the most in Lake Charles, Louisiana. Post-diagnosis, ophthalmic surgeons might wait 12 months to remove the lens for individual adult persons in Yakima, Washington, and about three weeks in Victoria, Texas [35]. It was also noted, that Latino and Asian-American groups tend to be enlisted for cataract operations more often than people of other ancestry or ethnicity [35].

Despite the "conventional logic" of ultra-violet exposure, persons that reside in a geographic region of high altitude (such as the Himalayas) do NOT show greater propensity for developing cataract [36]. In the desirable pursuit of higher intellectual attainments, and for the passion to do good, eye surgeons in the democratic republic of India seem to be more actively performing cataract surgical procedures in regions or states geographically situated, "south" of the Tropic of Cancer latitude [36].

*Footnote: The authors' usage in this paper, of the word "harmful" to describe an approved drug or class of medication, or multiple types of pharmaceutical agent, that are widely accepted among prescribing physicians (e.g. psychiatrists) should be taken-- not as a vicious assault upon their professional competence, but, instead, as a "friendly challenge" to their spirit of innovation.

Declaration: This paper should NOT serve to discourage consumption of fish/seafood. The authors [KA & MC] state clearly and assert with confidence, that we have no conflicts of interest to declare.

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