Review Article

RISK FACTORS WHICH LEAD TO DEVELOPMENT OF SENILE CATARACT: A REVIEW

ABSTRACT

Maturing processes including those brought about by various outside factors haves been standing out for researchers throughout the last years. Senile cataract is a multifactorial illness. Expense of surgery of cataract surgery medical procedure stays among the highest costing procedures in general public healthcare. Age is an essential element which causes senile cataract morbidity of which doubles every 10 years in life(Ref). This article considers some sources which portray research results on impact on cataract developmentdevelopment by risk factors like age, sex, race, smoking, alcohol consumption, diabetes (pancreatic), usage of specific drugs, various environmental factors aspects including ultraviolet and ionizing radiation; many of which are shown to cause increment increase or decrease in the risk of senile cataract; there are clashing information on specific factors. Depending on etiology experts spot out senile, congenital, traumatic, complicated and occupational cataract. Senile cataract (hereafter referred to as "cataract") is the most prevalent of all. The layout additionally contains quantitative data of cataract risk which are given through odds ratio and advance because of age, alcohol consumption, ionizing radiation, and so on. The researchers additionally express that still there is no finding to the query of whether dose effect relationship for cataract evolvement is an non-threshold or threshold. Surgical procedures are is the only treatment available. The surgical procedure usually needs takes less than an hour. The surgeon makes a small incision in the sclera or limbus of the eye, sometimes with a laser. Through the opening created, a small tool is put in to break up the cataract and gently suction it out. Then they put in the new lens, which is made of plastic, silicone, or acrylic, and close the incision. Surgical procedure namely phacoemulsification and small incision cataract surgery (SICS) are widely used for cataract surgeries; the former being the latest development in cataract surgeries and is less time taking. If both eyes are affected, two surgeries are done separately.

KEYWORD: senile cataract risk, multi-factor disease, factors, odds relation, relative risk, dose-effect relationship, age parameters.

INTRODUCTION

Cataract is any persistent opacity occurring in the lens substance or capsule. Cataract is a big medical, social and economic issue in many countries [1-3][4] leading to disorders of vision and blindness (33%) in the world[1][2]. Expenditure on cataract surgeries contribute to overall public health care expenditure considerably. Depending on etiology experts spot out senile, congenital, traumatic, complicated and occupational cataract. Senile cataract (hereafter referred to as "cataract") is the most prevalent of all.

There are three main types of cataracts based on clinical and anatomical features: cortical, nuclear and back sub-capsular; and can occur both separately and in combinations.[5] Nuclear cataract involves the opacification of central part (nucleus) of lens: the process of which is combined with sclerosis of lens fibres, along with the nucleus colour changing to yellowish or even brown, and with overall eyesight deterioration. Cortical cataract involves opacification of peripheral part of lens. With progression of age opacities appear in cortical area of lens (spoke-like or sectoral) which usually don't lead to any clinical symptoms until the lens optical axis area is involved in the process. Back subcapsular cataract (BSC) constitutes of a compact opacity which is located in the posterior area of the central cortex under the capsule. It usually occurs in younger age groups and causes a considerable loss of near vision activity.

Results obtained from various~~multiple~~ research on reasons for cataract evolvement revealed that cataract was a multi-factorial disease. Evolvement of cataract depends on age, sex, race, concomitant somatic or eye pathology, addictions (smoking), nutritional peculiarities as well as environmental factors, like exposure to ultraviolet radiation and ionizing radiation, and intake of certain medications [4][6]. This literature review not only explains the possible cause of some of the risk factors affecting cataract development but also draws a comparison amongst the risk factors as to find the most important and least important ones. It also helps us to find the avoidable factors.

OBJECTIVE- This review article outlines the risk factors of senile cataract. It also draws a rough comparison among the risk factors to have an idea of the most important ones and the least important ones through statistical data. This would in turn help doctors in having a rough idea of a patient being exposed to such factors and ease the process of diagnosis. From a social perspective it would bring down expense borne by the people for cataract surgeries by reducing its incidence.

METHODOLOGY- To comprehend this review article various literature search was done using pubmed , google scholar as well as from various ophthalmology journals like INDIAN JOURNAL OF OPHTHALMOLOGY in very aggressive manner.

Comment [E.1]: Why in capital, and which other journals.

NON-RADIATION FACTORS

AGE

Age is the basic factor leading to increased risk of cataract. Thus, prevalence of cataract among people of age group 52-62 is 5% [7]; among people of age group 60-69 is 30% and among people older than 70 years is 64% [8]. The fact that cataract associated morbidity doubles every 10 years after the age of 40 implies that all people belonging to age group 80-90 suffer from cataract [9]. The impact of~~d~~ oxygen free radicals on lens tissue are considered to be the main reason for opacification of lens which is a characteristic for senile cataract. A group of researchers found that age had a statistically significant influence on cataract evolvement of all types. Odds Ratio (OR) per each 10 years of life amounted to 9.90 (95%

CI: 8,20 – 11,90) for nuclear cataract; 3.06 (95% CI: 2,76 – 3,40) for cortical cataract; 3.09 (95% CI: 2.71 – 3.51) for back sub-capsular cataract; and 6.62 (95% CI: 5.78 – 7.63) for all cataract types.

SEX

After a lot of epidemiologic research researchers arrived to the conclusion that cataract risk was slightly higher for women than for men; however, the dependence still remains unclear. The work [11] contains some data on OR for morbidity with cataract among women which was 3.03 (95% CI: 1.83 – 5.00) against men. Another research [12] showed that cataract frequency was slightly higher among women than among men, OR being 1.55 (95% CI: 1.26 – 1.91). A third research performed as per "case- control" type revealed only a boundary dependence between ~~between~~ sex and cataract[13]. Some researches throw light on the substitutive hormonotherapy in women during a period after menopause [14] [15].

RACE

Some researchers state that there is a correlation between various cataract types and patients' race. S.K. West, B. Munoz et al. [16] revealed that the risk of African Americans developing cortical cataract was 4 times higher than White Americans while White Americans were more at a risk of developing nuclear or back sub-capsular cataract. Another research ~~reveled~~revealed that cortical cataract prevailed among Latin Americans [17].

SMOKING

Some researches showed a correlation between smoking and lens nuclear sclerosis and detected a dose-effect dependence; people who gave up on smoking were under a lower risk of o developing cataract than those who continued to do so [18] [19] [20] [21]. So, apparently there was a protective effect of giving up smoking.

Another research [10] showed that smokers had higher morbidity with nuclear cataract (OR = 2.06; 95% CI: 1.46 – 2.98), with cortical cataract (OR = 1.33; 95% CI: 1.02 – 1.74), with back sub-capsular cataract (OR = 1.39; 95% CI: 1.02 – 1.91), or with any cataract type (OR = 1.48; 95% CI: 1.10 – 1.99) after corrections as per age, sex, body mass index, arterial hypertension and diabetes. At the same time, another study [22] found no evidence of such dependency. Education up to elementary or secondary level (OR = 1.67; 95% CI: 1.06 – 2.64) and low monthly income increased nuclear cataract risk while living in a small apartment increased back subcapsular cataract risks (OR = 1.70; 95% CI: 1.28 – 2.25). Men who smoke have a 17.9% chance of developing nuclear cataracts, and it has been proven that a) smoking causes a statistically significant rise in senile cataracts (all types) independent of age, sex, body mass index, hypertension and diabetes; b) morbidity with nuclear cataract was related to how many cigarettes a patient smoked in a day, and it increased with increasing smoking index. If this addictive habit is avoided or reduced it can reduce chances of cataract.

ALCOHOL INTAKE

An essence of influence of alcohol on cataract genesis is still unknown. The lens is vulnerable to oxidative stress caused by alcohol as well as the direct toxic effects of alcohol and its metabolic products [23–25]. However, the data for a link between alcohol consumption and senile cataract is controversial. Beer abusers [26] and past alcoholics [27] had statistically significant higher cataract risks, according to "case-control" research findings. Two cohort examinations were conducted [28] [29] which indicated a positive but statistically insignificant link between alcohol consumption and cataract progression. Strong alcohol and wine consumption were linked to an increased risk of nuclear opacities, according to experts

studying certain cataract types (OR = 1.13; 95% CI: 1.02–1.26), whereas risks of cortical opacities were reduced on wine consumption (OR = 0.88; 95% CI:0.79–0.98) [31]. A statistically significant positive connection between alcohol consumption and the likelihood of "operated" cataracts was discovered in a population prospective cohort study [14]; the risk grew with an increase in overall consumed alcohol volume; relative risk of "operated" cataract amounted to 1.11 (95% CI: 1.02 – 1.21) after corrections as per age and other potential risk factors. Avoiding or reducing alcohol intake can reduce probability of cataract.

SOMATIC PATHOLOGY

PANCREATIC DIABETES

Pancreatic diabetes of both types (1 and 2) is one of the most significant somatic disorders that leads to increased cataract evolvement risk. In comparison to persons who did not have such a pathology, the odds ratio for cataract progression in people with pancreatic diabetes was 2.72 (95% CI: 1.72 – 4.28) according to research [11]. Another study [32] found that a dextrose level of less than 6 mmol/l in blood obtained on an empty stomach induced a higher risk of cataracts (OR = 1.79; 95% CI:1.25 – 2.57 against the dextrose level < 6 mmol/l). The same study found that a 1 mmol/l increase in dextrose levels in blood obtained on an empty stomach was linked to 5-year advancement in rear sub-capsular cataract (OR = 1.25; 95 percent CI: 1.15–1.35), as well as 10-year progress in cortical (OR = 1.14; 95 percent CI: 1.01–1.27) and nuclear cataracts (OR = 1.20; 95 percent CI: 1.01–1.43), with no threshold found. Furthermore, it was discovered that cataract surgery on patients with type 1 pancreatic diabetes needed to be done 20 years earlier than on people who did not have pancreatic diabetes [33]. Being an unavoidable factor patient is more vulnerable to developing cataract decades early in life.

MEDICATIONS

A lot of study has been done on the relationship between cataract progression and the use of various drugs. Both children [34] and adults [35] showed a link between system corticosteroid(GCS) intake, especially at high doses and over a long period of time, and cataract evolvement. It's worth noting that corticosteroid-induced cataracts are usually seen in the back of the lens (back sub-capsular cataract). It was also found that patients who used GCS had a higher risk of cataracts than those who did not [28-36][37][38][39][40]. Over the last few decades, statins have been extensively used to lower cholesterol levels in blood plasma and so prevent cardiovascular disease. Statins are known to have antioxidant properties, and their use may reduce the risk of cataracts. According to research [41], 5-year morbidity with cataract was lower (12.2 %) in those who used statins than in those who didn't (17.2%); the OR was 0.55 (95% CI: 0.36 – 0.84) when age was taken into account. With corrections for sex, age, and blood lipid levels, the OR for risk of cataract evolvement in non-smokers and people without pancreatic diabetes was 0.40 (95 percent CI: 0.18 – 0.90). It was seen that statins intake lowered risk of senile cataract. Although GCS as a medication cannot be avoided completely but judicial use should be promoted. Statins cannot completely prevent cataract but patients on statins have lesser chances of developing cataract.

IONIZING RADIATIONS

Lens is among the most radiosensitive organs in the human body. The effects of ionising radiation were found to cause cataract evolvement [42, 43]. Ionizing radiation affects the lens anterior capsule's cubical epithelial cells, which are found on the lens's surface. Damaged

cells then differentiate and migrate towards the peripheral cortex and lens back pole area, resulting in the development of opacities [43]. Age, sex, as well as dose, dose intensity, and irradiation fractioning, all influence the latent time and strength of effects [44, 45]. Radiation-induced cataracts were assumed to be a known long-term consequence based on some long-term study [46-47]. Several studies have linked distinct cataract forms to an increased risk of morbidity in a variety of people who have been exposed to ionising radiation. Nowadays, ionising radiation is assumed to cause higher risks of back sub-capsular cataracts, as well as cortical cataracts to a lesser extent. It's also worth noting that Nuclear cataracts are solely linked to age, as well as a few other risk factors However, the evidence for this connection is debatable. Demographically influenced radiations cannot be avoided but occupationally related exposure to radiations can be reduced.

IRRADIATION DUE TO ATOMIC BOMBING

Yamada et al. looked at a variety of non-tumor disorders among survivors of the atomic bombing in Japan who had been monitored by doctors for a long time (1958 - 1998) [48-52]. The findings of this study demonstrated a statistically significant positive link between cataract morbidity and irradiation doses ($p = 0.026$). The relative risk of cataract morbidity decreased statistically significantly when a person's age at the time of the examination increased (p 0.001), as did the length of time since the irradiation moment ($p = 0.09$).

IRRADIATION DUE TO THE CHERNOBYL NUCLEAR POWERPLANT DISASTER

Worgul et al. performed a research which revealed a statistically significant increase in non-nuclear (cortical and back subcapsular) cataracts: odds ratio per 1 Gy amounted to 1.65 (95% CI: 1.18 – 2.30), and a dose threshold for these cataracts was estimated to be equal to 0.50 (95% CI: 0.17 – 0.69) Gy. Odds ratio for all the cataract types amounted to 1.70 (95% CI: 1.22 – 2.38), and a threshold dose was equal to 1.50 (95% CI: 1.17 – 1.65) Gy.[53]

MEDICAL IRRADIATION

In 1999 Hall et al. examined the lens opacities frequency among Sweden population who had been exposed to ionizing irradiation in their childhood as a results of skin hemangioma treatment.[54] The lens opacities frequency was shown to be higher in people who had undergone radiotherapy in their childhood against the reference group (37% and 20% correspondingly).[54] After a correction per age at the examination moment odds ratio per 1 Gy was equal to 1.50 (95% CI: 1.15 – 1.95) for cortical cataract and to 1.49 (95% CI: 1.07 – 2.08) for bask subcapsular cataract.[55] Although it is unavoidable but it should be used judiciously.

COSMIC RADIATION

In 2001 Cucinotta et al. detected increased cataract evolvement risk in NASA astronauts.[56] A number of space flights being more than 2 against those who didn't have any or who participated in only one flight, astronauts' age, and a flight slope were statistically significant modifying factors. Hazard ratio (HR) for cataract evolvement at the age of 60 was estimated to be equal to 2.35 (95% CI: 1.01 – 5.51); and at the age of 65, 2.44 (95% CI: 1.20 – 4.98).[56-57]

OCCUPATIONAL IRRADIATION

Over the last years some data on cataract risks for workers exposed to occupational longterm irradiation have been collected.[58] A statistically significant linear correlation between morbidity with cataract and a total external gamma-irradiation dose was detected; excessive

relative risk (ERR/Gy) was equal to 0.28 (95% CI: 0.20 – 0.37).[58] Intervention surgeons are frequently subjected to long-term occupational irradiation, therefore cataract risk assessment has piqued their interest recently. Back sub-capsular opacities emerge at a statistically significant higher rate in intervention cardio-surgeons, according to research.[59] [60]. Unavoidable as it is, it can be reduced.[61-65]

CONCLUSION

To sum up the entire data, senile cataract is a multi-factor disease. Sex, age, smoking, alcohol intake, concomitant ophthalmologic pathology, some somatic disorders (for example, pancreatic diabetes), intake of certain drugs, UV radiation exposure, and so on have all been shown to be significant cataract risk factors. Researchers have discovered an elevated risk of specific cataract kinds when exposed to ionising radiation in recent years in addition to attempting to estimate a threshold dose of external gamma radiation for the progression of specific cataract types. Avoidance of some ~~of the avoidable~~ factors can help reduce chances of cataract and from a financial point of view prevent expenditure on cataract surgery in the society. The article also points out some drugs which can increase or decrease chances of cataract, namely GCS and statins respectively. Patients with some pre-existing pathology (pancreatic diabetes) are more prone to development of cataract. The article also throws light on the fact that radiations increase the chances of cataract as was seen in the population of Japan (atomic bombing) and Russia (chernobyl disaster) and also in medical staffs exposed to irradiations due to their occupation.

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