

The Effect of Exposure to Ultraviolet Rays of the Sun on Cataract Occurrence in Residents in Coastal Areas

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ABSTRACT

A cataract is a condition in which the crystalline lens of the eye becomes cloudy. One of the risk factors that make a person more susceptible to developing cataracts is frequent exposure to the sun's ultraviolet (UV) rays. Exposure to the sun's ultraviolet B (UVB) rays can accelerate the development of cataracts. A person who suffers from cataracts will complain of visual disturbances, such as decreased vision, foggy and smoky vision, double vision, glare when seeing, impaired colour vision, difficulty seeing when the light is dim or at night, and seeing halos around light. Management of cataract patients, namely surgical removal of the lens and replacing it with an intraocular lens (IOL). Prevention that can be done to reduce the risk of cataracts is to avoid sun exposure in the hours of the highest exposure intensity, wear sunglasses with UV filters, wear contact lenses with UV filters, and wear hats with wide edges.

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INTRODUCTION

Indonesia is an archipelagic country with the majority of its territory in the ocean. The total area of the Unitary State of the Republic of Indonesia is 8.3 million km² and 6.4 million km² is a water area with 16,671 islands (Badan Pusat Statistik, 2020). In Indonesia, the number of coastal communities and small islands is 16.42 million people (Kementrian Kelautan dan Perikanan Republik Indonesia, 2019). Research conducted by Laila, Raupong, & Saimin (2017) on residents in the coastal area of Kendari, found that residents who work outdoors have a 2.908 times greater risk of suffering from cataracts than residents who work indoors (Laila et al., 2017).

A cataract is a condition when the crystalline lens of the eye becomes cloudy (PK et al., 2018). In 2015 it was estimated that 253 million people in the world experienced visual impairment, one of which was caused by cataracts with a prevalence of 25.81% (Kementrian Kesehatan Republik Indonesia, 2018). Research conducted by Vashist et al. (2020) among residents in the coastal areas of Prakasam, the hills of Guwahati, and rural areas of Gurgaon India, the overall prevalence of cataract patients was 33.3% and the highest prevalence was in the coastal areas of Prakasam with a prevalence of 42.4% (Vashist et al., 2020). In Indonesia, cataracts are the main cause of blindness with a prevalence of 77.7% (Kementrian Kesehatan Republik Indonesia, 2018).

Research conducted by Rumerung, Rares, & Saerang (2016) in Amurang and Tomohon, North Sulawesi on residents of coastal and mountainous areas, it was found that the prevalence of people with senile cataracts living in coastal areas was 16.7% (Rumerung et al., 2016).

Research conducted by Vashist et al. (2020) on residents in the coastal areas of Prakasam, the hills of Guwahati, and rural areas of Gurgaon India showed an association between the incidence of cataracts and increased levels of exposure to UV rays from the sun (Vashist et al., 2020). Exposure to UV rays from the sun is one of the risk factors for cataracts (Ilyas & Yulianti, 2022). Exposure to UVB rays from the sun can accelerate the development of cataracts (Lam et al., 2015). Based on the description above, the authors are interested in compiling this literature review because residents in coastal areas have a high risk of suffering from cataracts.

METHOD

The method used in writing this literature review is a literature review. The search for library sources was carried out using the Pubmed website, Google Scholar, Google, and books. In the selection of library sources, the author uses publications in the last 10 years, namely 2012-2022 with a total of 19 kinds of literature.

RESULT AND DISCUSSION

Definition and Epidemiology

The word cataract comes from the Greek (katarrhakies) and English (cataract) which means waterfall. In Indonesia, a cataract is often called a person's vision that is covered by a waterfall because the lens is cloudy. A cataract is a condition of the lens that experiences cloudiness due to the addition of fluid in the lens and the denaturation of lens proteins (Ilyas & Yulianti, 2022).

In the world, cataracts cause visual impairment with a prevalence of 25.81% (Kementrian Kesehatan Republik Indonesia, 2018). Research conducted by Vashist et al. (2020) on residents in the coastal areas of Prakasam, the hills of Guwahati, and rural areas of Gurgaon India, it was found that the overall prevalence of cataract sufferers was 33.3% and the highest prevalence in areas with residents suffering from cataracts was the coastal area of Prakasam with a prevalence of 42, 4% (Vashist et al., 2020). One of the countries that have the largest number of people with visual impairments is Indonesia. In Indonesia, cataract is the main cause of blindness with a prevalence of 77.7%. The high prevalence of blindness caused by cataracts shows that there are still many Indonesians who suffer from cataracts that have not been operated on. The main causes of the Indonesian population who suffer from cataracts that have not been operated on include, cost problems (prevalence in the provinces of North Sulawesi (40.5%), Maluku (36.6%), North Sumatra (33.3%), West Sumatra (33.3%). %), West Java (31.9%), East Java (31.5%), and West Nusa Tenggara (25.5%)); residents are afraid to have surgery (prevalence in the province of Jakarta (30.3%)); residents feel no need for surgery (prevalence in South Sulawesi province (49.7%)); and residents do not know that they are suffering from cataracts (prevalence in the provinces of South Kalimantan (45.3%), East Nusa Tenggara (44.4%), West Papua (43.5%), Central Java (41.3%), Sumatra South (40.3%), and Bali (26.8%)) (Kementrian Kesehatan Republik Indonesia, 2018). Research conducted by Rumerung, Rares, & Saerang (2016) on residents of coastal and mountainous areas in Amurang and Tomohon, North Sulawesi, found the prevalence of people with senile cataracts living in coastal areas was 16.7% (Rumerung et al., 2016).

Risk Factor

Risk factors that make a person more prone to developing cataracts include frequent exposure to ultraviolet (UV) sunlight, smoking, diabetes mellitus, long-term steroid use, eye trauma, intraocular inflammation, family history of cataracts, and eye surgery (Ilyas & Yulianti, 2022). Research conducted by Vashist et al. (2020) on residents in the coastal areas of Prakasam, the hills

of Guwahati, and rural areas of Gurgaon India, showed a relationship between the incidence of cataracts and increased levels of exposure to UV rays from the sun (Vashist et al., 2020). Research conducted by Laila, Raupong, & Saimin (2017) on residents in the coastal area of Kendari, found that residents who work outdoors have a 2.908 times greater risk of suffering from cataracts than residents who work indoors (Laila et al., 2017).

According to Yunaningsih et al., (2017) UV exposure appears to be more pronounced as a factor in the formation of senile cataracts. Brilliant and colleagues reported a positive relationship between the prevalence of cataracts and the length of sun exposure. The effect of being exposed to the sun continuously for a long time will cause clouding of the eye lens, this can lead to research conducted by Aprilia (2020) stating that outdoor work is closely related to sun exposure. Because sun exposure has a statistically significant relationship with the incidence of cataracts. The effects of ultraviolet radiation from the sun continuously can cause clouding of the eye lens and cause cataracts.

Pathophysiology

Ultraviolet (UV) light can be divided into three, namely ultraviolet A (UV A) with a wavelength of 315-400 nm, ultraviolet B (UV B) with a wavelength of 280-315 nm, and ultraviolet C (UV C) with a wavelength of 280-315 nm. waves of 100-280 nm (Yam & Kwok, 2014). The sun's UVB radiation with a wavelength of 300 nm that enters the eye will be absorbed by the cornea by 92%, the aqueous humour by 6%, and the lens of the eye by 2%, while the sun's UVA radiation with a wavelength of 340 nm enters the eye. will be absorbed by the cornea by 37%, aqueous humour by 14%, and the lens of the eye by 48%, and UV C radiation from the sun will be absorbed by the ozone layer so that when it enters the eye it will be completely absorbed by the cornea. Radiation that is harmful to the lens tissue of the eye is UVB radiation from the sun (Haag et al., 2021). Exposure to UVB rays from the sun can accelerate the development of cataracts (Lam et al., 2015). The formation of Reactive Oxygen Species (ROS) by exposure to UV light and decreased activity of enzymes that catalyze the reduction of peroxide radicals to oxygen and alcohol, as well as enzymes that catalyze hydrogen peroxide reductase to oxygen and water are the main factors causing cataracts. The concentration of H₂O₂ present in the aqueous humour becomes very high when the oxidant concentration is high in the lens. In the development of cataracts, H₂O₂ also plays a role in reducing antioxidant reductase activity and defence enzyme activity in the lenses of cataract patients (Ivanov et al., 2018).

Residents who work outdoors will be exposed to UV B rays from the sun which is a factor that has a relationship with the development of cataracts. Acute UV exposure will have an impact on a person's lens and cornea, while chronic UV exposure at a significant level and for a long period will cause a person to experience cloudiness of the lens, resulting in an oxidation process by free radicals of sun's UV rays on lipid membranes and enzymes. protein/structure/DNA, which will cause the nucleus and cortical lens to become cloudy (Laila et al., 2017).

According to Irawan et al., (2020) Cataract pathogenesis is characterized by the appearance of protein aggregates that scatter light and reduce the transparency of the eye lens. In addition, there is a change in the protein that causes a change in colour to yellowish or brownish. Cataract formation in humans can occur due to many factors. Factors that influence the formation of cataracts include oxidative damage, damage caused by ultraviolet light, and malnutrition (Suparti & Purwanti, 2017)

Clinical Manifestation

People who suffer from cataracts will complain of visual disturbances. Visual disturbances experienced by cataract sufferers include decreased vision, foggy and smoky vision, double vision, glare when seeing, impaired color vision, difficulty seeing in dim light or at night, and seeing halos around light. In cataracts, there is cloudiness in the lens of the eye which causes the lens to become

not transparent, so the pupil will change color to gray or white (Ilyas & Yulianti, 2022). In addition, other symptoms commonly experienced by people suffering from cataracts are changes in vision perception when using contact lenses or glasses (National Eye Institute, 2015). The onset of complaints is generally slow and there is a progressive decrease in visual function (Nash, 2013).

Management

The standard of cataract management is surgical removal of the lens that has cataracts and replacing the lens using an intraocular lens (IOL) (Liu et al., 2017). Before IOL was introduced, after undergoing cataract surgery, cataract patients became aphakia, thus requiring high-power hyperopic glasses in order to refract light and focus visually on the retina (Davis, 2016). An indication for cataract surgery is that a person experiences loss of vision of a severity sufficient to accept the potential risks of cataract surgery. Rare indications for cataract surgery are to heal the lens caused by inflammation, adequately visualize the retina, or prevent glaucoma. The outcome of cataract surgery does not depend on the visual acuity of preoperative patients, but a thorough preoperative assessment, intraoperative and postoperative management, and IOL strength are still involved in a good surgical outcome (Liu et al., 2017). Cataract surgery can cause several complications, including complications during cataract surgery (posterior capsule rupture, nucleus drop, and shallowing of the anterior chamber) and complications after cataract surgery (endophthalmitis, secondary glaucoma, corneal edema, retinal detachment, chronic uveitis, posterior capsule opacification, surgical induced astigmatism, bleeding, cystoid macular edema, IOL dislocation, and toxic anterior segment syndrome) (Astari, 2018).

The types of cataract surgery, including: (1) Intra Capsular Cataract Extraction (ICCE), Intra Capsular Cataract Extraction (ICCE) is an operation by removing the entire lens and its capsule. In the postoperative condition of ICCE without IOL, the results are not good, so that ICCE without IOL has begun to be abandoned. Currently, ICCE is only performed in cases of luxation and subluxation lenses. (2) Extra Capsular Cataract Extraction (ECCE), Extra Capsular Cataract Extraction (ECCE) is an operation on a lens that has cataracts by removing the contents of the lens, which makes a tear in the anterior lens capsule, so that the mass in the lens and lens cortex can be removed through the tear. ECCE was performed on patients with mature cataracts. In mature cataract patients with severe endothelial abnormalities, the treatment that can be chosen is ECCE with keratoplasty. In ECCE, it takes 5 to 7 stitches to close the wound, because the size of the removed lens is about 9 to 12 mm, so the risk of postoperative astigmatism is high. However, the risk of astigmatism can be reduced by an operator who has experience in adjusting suture strength. (3) Small Incision Cataract Surgery (SICS), Small Incision Cataract Surgery (SICS) is a cataract operation that is performed manually by making a smaller incision than ECCE. In SICS the incision size is 6 to 9 mm and the tunnel size is 4 mm. The risk of postoperative astigmatism can be reduced by sealing the wound even without sutures due to the smaller incision size. In the SICS procedure, the wound is incised more towards the sclera and makes a tunnel from the sclera to the cornea, then it will penetrate the anterior chamber of the eye. In the SICS wound incision, some doctors choose to do one suture with the aim of closing the wound incision better. The gold standard for SICS surgery is the installation of an IOL for SICS surgery. (4) Phacoemulsification, Phacoemulsification is a cataract surgery procedure that uses a phacoemulsification machine by crushing the lens to become softer, making it easier to remove it through a 2 to 3-mm wound (smaller wound). If the cataract has become smaller or becomes soft, then it will be aspirated with a peristaltic pump or venturi mechanism until it becomes clean. With a smaller incision, there is no need for stitches and will heal on its own, so cataract sufferers will quickly be able to return to their normal activities. The vibration used in destroying cataracts is the vibration of the piezoelectric crystal with ultrasound frequency on the phaco handpiece. The standard operation for phacoemulsification is the installation of an IOL and the gold standard for phacoemulsification surgery, namely using a foldable lens (the lens that can be folded). However, due to the limited

selection of IOLs available, the use of non-foldable IOLs is still allowed. The phacoemulsification action is beneficial in senile cataracts and traumatic congenital cataracts. The advantage of phacoemulsification is that the incision is smaller and will recover on its own, so cataract sufferers will quickly be able to return to their normal activities (Kementrian Kesehatan Republik Indonesia, 2018).

Prevention

The most effective way that can be used to protect the eyes from sun exposure is to avoid sun exposure in the hours of the highest exposure intensity. In addition, ways to protect the eyes from solar radiation, namely by wearing sunglasses with UV filters, wearing contact lenses with UV filters, and wearing hats with wide edges. Wearing sunglasses can block sunlight from reaching your eyes by constricting the pupils. By wearing sunglasses, excessive amounts of light cannot enter the eye through the dilated pupil. The use of contact lenses that cover the entire limbus and cornea can provide protection to the eye (Łatka et al., 2018).

According to Ahmad & Mayasari (2022), prevention can be done by providing counselling regarding efforts to prevent the worsening of the patient's eyes, Counseling on foods that the patient can eat so that there is no deterioration in the patient's eye condition. The use of glasses is needed to correct a temporary decrease in vision before surgery. However, the use of glasses cannot definitively treat cataracts. It is recommended that cataract surgery be carried out immediately for total therapy so that vision can improve immediately (Chen et al., 2021).

CONCLUSION

A cataract is a condition where the lens becomes cloudy. Exposure to the sun's UVB rays can accelerate the development of cataracts. Symptoms experienced by cataract sufferers are visual disturbances. Cataract management, namely surgical removal of the lens and replacement of the lens with an IOL. Prevention of cataracts, namely avoiding sun exposure in the hours of the highest exposure intensity, wearing sunglasses with UV filters, wearing contact lenses with UV filters, and wearing hats with wide edges.

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