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EARLY CATARACTS ASSOCIATED WITH HIGH DEGREE MYOPIA: A BIBLIOGRAPHICAL REVIEW

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Abstract: Cataracts correspond to a visual dysfunction resulting from the opacification of the lens, tending to occur after the age of 50. If this pathology begins before this period, it is called early cataract and may be related to exposure to chemicals, solar radiation, or eye injuries. However, recent studies have raised the possibility of a correlation between the development of early cataracts and previous cases of high-grade myopia, which could justify its appearance in individuals under 50 years of age, due to intense ocular degeneration. Therefore, the present study aims to analyze the existence of a relationship between the emergence of early cataracts and previous high-grade myopia, presenting concepts about the pathophysiology of the aforementioned diseases and the importance of ophthalmological evaluation in myopic patients. For the development of the project, original articles published in English and Portuguese over the last 28 years were collected in the main bibliographic databases, such as SciELO and PubMed, to ensure greater reliability of the information presented. It was then realized that the relationship between high-grade myopia and early cataracts requires greater attention from health professionals, considering that the need to increase lens power for myopic correction can, consequently, aggravate the lens density with the age. Therefore, patients under 50 years of age and those with high-grade myopia are more likely to develop early cataracts. Prior diagnosis, made by the ophthalmologist, and appropriate treatment are essential to guarantee the patient's quality of life and minimize the risks inherent to the pathology, based on the assessment of the extent of the cataract, as well as defining clinical or surgical management. Furthermore, awareness and care for eye health are essential to prevent early cataracts associated with high-grade myopia, ensuring healthy vision for the patient.

Keywords: High grade; Early cataract; Myopia; Ophthalmology.

INTRODUCTION

According to the World Health Organization (WHO), cataracts are one of the main causes of treatable blindness in the world, affecting around 20 million people, corresponding to around 40% of the world's blind population. This disease causes opacification or clouding of the lens or its capsule, which prevents the passage of light to the retina of the eye. It can affect both the elderly and adults and even children (SHEELADEVI, et al., 2016). Furthermore, cataracts are subdivided into four classes, which are congenital, early onset, late onset and acquired, which includes all other forms of cataracts, including those related to age (DUBOIS; BASTAWROUS, 2017).

On the other hand, myopia is a common refractive error that affects up to 25% of the world's population, and is considered a public health problem. It occurs when the image of a distant object forms anterior to the retina, with the ciliary muscle at rest, most commonly due to the increase in the axial length of the eye. As a result, there is a reduction in distance vision, requiring refractive correction through the use of glasses, contact lenses or surgery depending on each case (VILAR, et al., 2016). This pathology is divided into primary and secondary. The primary forms are subdivided into physiological, intermediate, pathological and curvature. Secondary forms result from structural changes in the eyeball.

Regarding the classification of myopia according to the degree, there is low myopia up to 3 degrees, moderate myopia from 3 to 6 degrees, and high myopia, which is a diopter greater than 6.0. This condition is associated with a greater risk of developing eye complications, such as retinal detachment and glaucoma. Furthermore, it can lead to significant loss of vision and the need for more complex surgical interventions (SBO, 2021).

According to Rodrigues et al. (2015), early cataract is usually associated with myopia, particularly in patients with a high degree. These patients have a higher risk of developing an early cataract when compared to individuals without myopia or with low myopia. It is believed that early cataracts associated with myopia are correlated with changes in lens metabolism, caused by axial elongation of the eyeball. This can lead to a change in lens proteins, making them less soluble and leading to the formation of protein aggregates, which lead to opacity of the lens.

This project aims to highlight the correlation between high-grade myopia and the development of cataracts before the fifth decade of life, highlighting the importance of early ophthalmological evaluation in myopic patients, as these individuals are at greater risk of progression to lens involvement. . Furthermore, the article also highlights the lack of individualized management in the treatment of cataracts in myopic patients, as a result of the greater complexity and risk of surgical complications in this case, which can help guide preventive and therapeutic measures appropriate to the population.

METHODOLOGY

To prepare this project, scientific articles published in Portuguese and English were collected over the last 28 years, obtained from the SciELO and PubMed databases, as preponderant bibliographic sources. Furthermore, an analysis of the selected articles was carried out, seeking the greatest amount of relevant information that could contribute to the theme proposed in the study, in order to evaluate the possible relationship between the development of cataracts, early, when there is prior high-grade myopia.

BIBLIOGRAPHIC REVIEW

PHYSIOLOGY OF VISION

The image that humans are able to see is produced from a translation that the brain carries out of the light stimuli that reach the eyes. The light stimulus goes beyond the cornea, pupil, lens and then reaches the region of the retina, where the stimulus is transduced by specialized cells that encode the image. After these processes, the image is conducted to the cerebral cortex by the optic nerve, allowing vision (NILSSON, 2021).

In this context involving the physiology of vision, it is important to highlight that the pupil controls the entry of light according to the brightness of the environment, functioning as an ocular diaphragm. In places with greater light, the iris contracts and minimizes the pupil diameter, which then reduces the entry of light and, consequently, focuses the light ray in the center of the retina. In environments with lower light, the iris dilates and expands the pupil diameter, increasing the passage of light rays (BURGER, et al., 2021).

The lens and cornea function like the lenses of a camera, having the function of focusing and concentrating the light rays sent to the retina. Therefore, when light does not reach the retina effectively, there is an irregularity in the formation of the image, resulting in the main vision pathologies: hyperopia, astigmatism, presbyopia and myopia. Furthermore, when light hits the retina, specialized cells are stimulated, such as cones, responsible for color vision, and rods, responsible for night vision (DE NAVA, 2022).

In certain pathologies, such as myopia and cataracts, the normal physiology of vision is affected, impairing the quality of life of affected individuals. Myopia is one of the most common pathologies involving vision and occurs due to inadequate focusing of the visual image on the retina, which occurs more anteriorly to the appropriate location, consequently generating difficulty in identifying distant objects. Cataracts, in turn, result from the opacification of the lens, impairing the passage of light stimulus and affecting the formation of a clear image (STEWART, 2020).

CATARACT PATHOPHYSIOLOGY

Cataracts occur through the opacification of the lens, resulting in a decrease in visual acuity. Its causality has a broad aspect, which must be assessed in detail, some of which are: pregnancy associated with infectious diseases, poor maternal nutrition and low oxygenation, factors that can lead to congenital cataracts. Another prominent cause is senile cataract, which affects a large proportion of affected individuals, resulting from physiological aging itself. Furthermore, there are traumatic cataracts, which are commonly related to unilaterality in young adults.

However, the cause is also intense exposure to ultraviolet radiation, causing exfoliation of the lens, which causes cataracts, a mechanism that also applies to the appearance of opacification in patients undergoing radiotherapy treatment. Furthermore, some endocrine and metabolic diseases may be predisposing to the emergence of cataracts, such as atopic dermatitis, myotonic dystrophy and neurofibromatosis type 2, hypoparathyroidism, diabetes mellitus, galactosemia, cretinism and hypocalcemia (KELKAR, et al., 2018). Finally, ocular diseases can also predispose the individual to cataracts, such as myopia and chronic anterior uveitis.

> The fact that practically all people, at some stage of involution, present some degree of lens opacity, the lack of knowledge about the pathophysiology, the associations with ocular and systemic diseases, the incapacitation it brings to the individual, and the diversity of ways in which ophthalmologists conduct the

> treatment, until surgery is reached, making this chapter one of the most important in Ophthalmology. (DE SOUZA, *et al*., 1997).

Regarding the pathophysiological aspects of cataracts, its anatomical structure is affected, the lens, which is surrounded by capsules called cortical layers and the nucleus. Its composition consists of two main parts: the cortex and the nucleus. The cortex is located in the most superficial part and contains younger fibers. The nucleus, in turn, is in the deepest part, containing older fibers (LOPES, et al., 2021).

The pathophysiology of cataract is comprehensive and still poorly defined, but the mechanisms overlap due to the characteristic loss of transparency and degenerative processes that denature the proteins in its fibers, naming the main types of cataract as: nuclear, cortical, congenital and posterior subcapsular, respectively. The mechanism of nuclear cataract occurs through oxidative damage generated in the lens. The cortical, in turn, results from deposition in the peripheral part of the lens, in the cortex, characterized as a "wedge"-shaped opacity. Congenital, occurs due to disorders that can occur at any level of lens growth. Finally, posterior subcapsular cataracts occur in the back of the lens, just below its capsule, and are commonly found in diabetics and corticosteroid users. All of these areas lead to a worsening of visual acuity, directly affecting the individual's quality of life.

> Furthermore, changes in relation to the visual field, acuity, proprioception, contrast or glare are associated with the morbidity and mortality profile, concern about the risk of falling, physical performance, quality of life, anxiety and depression. (DOMINGUES, *et al*., 2016).

CATARACT EPIDEMIOLOGY

According to the Brazilian Institute of Geography and Statistics (IBGE), confirmed by the Brazilian Society of Ophthalmology, there are more than six million people with visual impairment in the world, with the most vulnerable group being the elderly, whose prevalence increases with age (ALMANÇA, et al., 2018). Cataracts, in turn, are the main cause of blindness in the world, responsible for 51% of cases. According to the WHO, the annual incidence of cataracts is estimated at 0.3% per year. This would represent, in Brazil, around 550,000 new cases of cataract per year (OLIVEIRA, et al., 2011).

It is known that the diagnosis is clinical and includes anamnesis and a thorough ophthalmological examination, which confirms the loss of visual acuity accompanied by opacification of the lens. This way, following this early diagnosis, it is possible to effectively reduce blindness. According to the World Health Organization, 80% of blindness cases could be avoided if there was greater attention to preventive interventions and/or treatments(ÁVILA, *et al*., 2015).

Furthermore, today, Brazil is going through a process of demographic transition in which the number of elderly people has been growing exponentially. According to statistics, by 2050 the number of elderly people will exceed that of children, which has a direct impact on the health service. In this sense, with cataracts as a disease that affects more elderly people, there must be preparation in all areas of health, including public policies to receive ophthalmological demands.

LOCS III

In the preoperative assessment of cataract surgery, the most clinically effective method used is the Lens Opacities Classification System III (LOCS III) classification. This way, the opacification of the lens is assessed

using six standardized images, taken using a slit lamp. As a result, opalescence and nuclear color are analyzed, as well as retroillumination to scale posterior subscapular and cortical cataracts. Therefore, aiming for an objective classification of cataracts, photographic use is viable, since they subdivide the main types into different degrees (CORREIA, 2017).

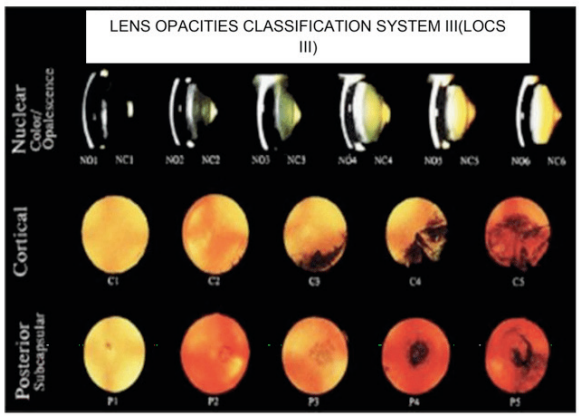

Figure 1. Classification Lens Opacities Classification System III (LOCS III)

Source: Adapted from HUSEMANN, 2019.

In this sense, the grades take into consideration, parameters such as density and color (when nuclear) and according to the anatomical area of the cataract (cortical and posterior subcapsular area). Therefore, the patient's visual acuity is affected in different ways, depending on the type and degree of the cataract. Thus, according to LOCS III, grade 4 nuclear cataracts affect the visual scope for opalescence and grade 5 cataracts for color. Cortical cataracts affect visual capacity at grade 3 and those classified as posterior subcapsular cataracts cause negative effects at all grades (HUSEMANN, 2019).

SLIT LAMP BIOMICROSCOPY

In the scope of diagnosis, the ophthalmological examination performed is slit lamp biomicroscopy. This way, the ophthalmologist can observe the loss of transparency of the eye's natural lens, called the crystalline lens. The method, however, is carried out using direct and diffuse lighting and the parallelepiped makes it possible to locate the opacity, as well as allowing differentiation of its appearance (ALLEMANN, 1995).

Furthermore, the optical cut covers and studies the disjunction lines, also evaluating the depth established by each change. In addition, specular microscopy evaluates the anterior and posterior color, which has a golden honeycomb appearance located in the subcapsular space. Finally, with the red field, it is possible to study the entire posterior capsule and a part of the posterior lens, enabling the detection of small opacities not noticed beforehand (SAFATLE, 2012).

Opacification of the lens.
Loss of contrast and image definition.
Reduced visual acuity.
Change in pupil color.
Displacement of the iris position.
Increased depth of the anterior chamber.
Presence of other associated eye conditions, such as macular degeneration or glaucoma.

Table 1. Findings on slit-lamp optical biomicroscopy in patients with cataracts.

Source: Adapted from RAU, 2013.

PATHOPHYSIOLOGY OF MYOPIA

Myopia is a condition that occurs due to an error in visual refraction, a situation in which the optical system is excessive in relation to the length of the eyeball. This occurrence may derive from the axial length of the eyes, or when the refractive power of the cornea and crystalline lens are excessive (DANTAS, et al., 2023). Although myopia

most commonly occurs as a consequence of eye size dysfunction, disorders in the curvature of the cornea and lens can occur concomitantly. Therefore, in both cases, the image presented by means of light beams will be focused anteriorly to the retina, and, as a result of this error, the light rays will produce blurs on the retina, leaving the final image blurry (SOUZA, 2022).

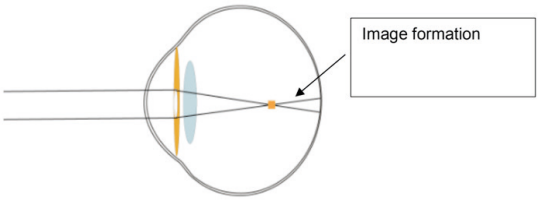

Figure 2. Image focused anterior to the retina.

Source: Adapted from SOUZA, 2022

Healthy newborns commonly have a small degree of myopia that tends to regress by the age of 4. Despite this, early onset of the disease has a worse prognosis. When developed before the age of 10, approximately 17.5% of children will present myopia greater than -6 diopters, in different ways, whereas myopia manifested after the age of 16, only around 1% will present with a degree greater than -6 diopters. In this sense, it is understood that late onset is a good prognosis regarding high grade. Furthermore, it is important to highlight that mild and moderate degrees are generally well tolerated by infants, and therefore are not corrected until the school stage, however, it is important that follow-up with an ophthalmologist is carried out due to the risk of developing amblyopia (SOUZA-DIAS, 2018).

HIGH DEGREE MYOPIA

It is a consensus that myopia is determined by spherical refractive error ≤ -0.5 diopters, with accommodation being at a moment of relaxation. The classification varies according to the dioptric value in the eyes, being considered a low or moderate degree when it is between -0.5 and -6.0 and, when it exceeds -6.0 it is defined as a high degree. Furthermore, studies indicate that the development of severe myopia is related to genetic factors, while the development of low-grade myopia is more closely related to environmental factors. However, it is clear that genetics and the environment combined can lead to greater evolution of the condition (WOLFFSOHN, et al., 2019).

RELATIONSHIP BETWEEN HIGH-GRADE MYOPIA AND EARLY CATARACTS

Although the pathophysiological processes that explain the association between high-grade myopia and early cataract are not fully known, it is known that this relationship exists and influences, mainly, the development of nuclear cataract and posterior subcapsular cataract, the bad prognosis for these patients with myopia influenced by greater ocular axial length and retinal degeneration (JEON; KIM, 2011). It is important to highlight that there is a greater association with nuclear cataract, the explanation of which is not fully understood, but is attributed to the increase in lens power influenced by the increase in lens density with age (WONG, et al., 2001).

The main explanation would be the fact that myopia generates a change in the shape of the eyeball, which probably accelerates the process of opacification of the lens, generating cataracts. Other hypotheses revolve around the correlation between the degree of lipid peroxidation in the myopic retina and the genesis of cataracts, which has been observed in rodents, as well as the possible relationship between the formation of products due to external damage that would trigger cataracts (JEON; KIM, 2011).

FINAL CONSIDERATIONS

Although the relationship between early cataracts and high-grade myopia is not detailed in detail, this ophthalmological condition requires special attention from health professionals. This problem is attributed to the need to increase lens power due to the increase in lens density with age. Therefore, myopia is a risk factor for the early development of cataracts, especially in patients under 50 years of age. Early detection and appropriate treatment are essential to ensure good vision and quality of life for patients. The diagnosis must be made by an ophthalmologist, who can use specific tests to assess the extent of the cataract and define the best treatment, which can be clinical or surgical.

Phacoemulsification with intraocular lens (IOL) fixation is a safe and effective procedure, but must be performed with caution in patients with high-grade myopia due to possible complications. Therefore, it is essential that the patient follows medical recommendations and undergoes regular follow-up with the ophthalmologist. In short, awareness and care for eye health are the key to preventing and treating early cataracts associated with high-grade myopia, ensuring healthy vision and quality of life for patients.

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