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Mera Skoblo

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Mera Skoblo, graduated with a Bachelor of Science degree in Biology in January 2022 and is accepted to SUNY Downstate PA program

Abstract

Retinal detachment is one of the few ocular emergencies. Depending on the extensiveness of the detachment, and whether it is macula on or macula off, will affect the patient's visual acuity after treatment. Therefore, it is vital that after experiencing any common retinal detachment symptoms, the patient sees an ophthalmologist immediately. High-risk factors for retinal detachment include aging, ocular trauma, high myopia, and prior eye surgery. Statistically, the cause of a given retinal detachment often determines the specific type of detachment that occurs. There are three forms of retinal detachment, categorized separately based on their anatomical characteristics.

Introduction

Everywhere we go, we are surrounded by the wondrous creations of G-d. Our eyes, a pair of those creations, are organs, each one intricately curated to provide us with vision. The structure of an eye is a formation of three layers of tissue surrounding a fluid-filled sphere. The sclera is the most external tissue, which transforms into the cornea at the front of the eye (Purves et al., 2001). This is where light initially enters and begins its pathway to be translated into the images we see. The light energy travels through the eye until it reaches the retina, the innermost layer of the eye, where it is converted into electrical energy. The electrical signals then travel through the remainder of the eye, reaching the optic nerve, where they will then continue onto the occipital lobe to be interpreted into vision. If anything along this path were to become damaged, it would result in reduced vision and sometimes even blindness (Rehman et al., 2021).

The retina is the site of conversion from light energy to electrical energy due to its neuronal makeup. Five major neuronal cell classes form the retina, along with Muller glial cells for support and protection. Two of these classes are photoreceptors, which can be further categorized into rods and cones. These photoreceptors are the ones that receive light energy and convert it into electrical energy, enabling the signals to be transmitted through the brain (Hoon et al., 2014).

The blood supply for the retina comes from multiple sources, including the central retinal artery (CRA) and the choroid, a rich capillary bed within the middle layer of the eye, which receives its blood supply from the posterior ciliary bodies (Purves et al., 2001). However, certain layers of the retina rely entirely on the choroid for their blood and oxygen supply, specifically the photoreceptor cells. Lying on the posterior portion of the retina is the macula lutea, the area responsible for central vision. The fovea centralis, which is the central portion of the macula, is densely packed with photoreceptor cells, primarily cones (Kolb, 2005). If the macula (inclusive with the fovea) becomes detached from the choroid, it would result in apoptosis of the photoreceptor cells and probable blindness (Ghazi, Green, 2002, & Kolb, 2005).

Retinal detachment (RD) is one of the few ocular emergencies; it occurs when the neurosensory retina (NSR) separates from its underlying membrane, the retinal pigment epithelium (RPE), and therefore, from the choroid as well (Ghazi, Green, 2002). Depending on the extensiveness of the detachment, and whether or not the macula is detached as well, will determine the chances of regaining decent vision post retinal detachment treatment. Therefore, it is a time-sensitive emergency, because although initially localized, it can progress and go from a partial to a complete retinal detachment.

Methods

Research for this paper was conducted with the use of databases available through Touro College Library, such as ProQuest and EBSCO, along with Google Scholar.

Discussion

To begin, we will discuss the different classifications of retinal detachment and then go on to discuss causes and the most likely type of retinal detachment that each corresponds to.

Types of Retinal Detachment

Retinal detachment is classified into three different types based on anatomical characteristics.

1. Rhegmatogenous retinal detachment (RRD)
2. Tractional retinal detachment (TRD)
3. Exudative retinal detachment

Rhegmatogenous retinal detachment is the most common type of retinal detachment, occurring in about 1 in 10,000 persons per year (Feltgen, Walter, 2014). This form of retinal detachment is a result of a retinal break, which can be seen in the name, "'rhegma,' meaning a rent or a fissure" (Jalali, 2003). Vitreous humor from the vitreous cavity seeps through the retinal break, pushing the neurosensory retina away from the underlying retinal pigment epithelium and choroid. Rhegmatogenous retinal detachment can occur at any age "but reaches peak prevalence in people aged 60 to 70 years" (Fraser, Steel, 2010).

Tractional retinal detachment is due to "pre-retinal membrane formation and scarring that pulls the retina from its

attachment" (Jalali, 2003). On the other hand, exudative retinal detachment develops due to fluid from the retina and/or choroidal vessels collecting in the subretinal space, which is the area between the photoreceptors (neurosensory retina) and the retinal pigment epithelium (Amer et al., 2017). Exudative retinal detachment occurs in the absence of retinal breaks or traction (Ghazi, Green, 2002).

The latter two classifications of retinal detachment, tractional and exudative, are far less common than the rhegmatogenous form. However, all causes of retinal detachment share one common characteristic: the accumulation of subretinal fluid (Ghazi, Green, 2002).

Symptoms

The most common symptom of retinal detachment is "sudden, painless loss of vision or blurring of vision in the affected eye." Some patients also undergo field loss, which they describe as a "veil or shadow in one area of their vision." Flashes or floaters may also occur "due to vitreous degeneration and its traction on the retina" (Jalali, 2003). It is the responsibility of the doctor to inform and educate high-risk patients of these symptoms and the importance of seeing an ophthalmologist immediately after experiencing any of the aforementioned signs.

Potential Causes

Risk factors, such as aging, ocular trauma, high myopia (nearsightedness greater than -6.00 diopters), or prior eye surgery can predispose a patient to retinal detachment (Kwok et al., 2020). However, these factors do not warrant that a patient will definitely experience retinal detachment, only that there is a greater incidence of it occurring than in those who do not possess any of these risk factors. Patients with any of the aforementioned conditions should have routine ophthalmic exams, allowing the doctor to perform dilated examinations and collect diagnostic imaging for future reference (Jalali, 2003). Such imaging tools can include optical coherence tomography (OCT) and fundus photographs, each providing different views of the retina. If somebody is experiencing retinal detachment symptoms, it is vital that they see an ophthalmologist immediately (Williams, Hammond, 2019). The sooner a patient sees an ophthalmologist to confirm or deny a retinal detachment will increase the chances of preserving visual acuity. Unfortunately, "it has been estimated that between 50% and 70% of patients present too late because they did not recognize the typical symptoms of detachments." It is, therefore, very important "to ensure that high-risk patients are informed accordingly" (Feltgen, Walter, 2014).

Aging

One of the most common risk factors of retinal detachment is aging. The type of retinal detachment that occurs due to aging is rhegmatogenous retinal detachment (Feltgen, Walter, 2014). Generally, "the annual incidence of RRD range[s] from 6.3 to 17.9 per 100,000 population globally, however, for those aged "70 to 79 years old, the incidences [of retinal detachment] vary from 15.21 to 50 per 100,000 worldwide" (Ma et al., 2014). The reason for this is that as people age, changes occur in the structure of their eyes, and complications can cause retinal issues (Salvi et al., 2006). One such change involves the vitreous humor, the gelatinous substance filling the space between the back of the lens of the eye and the surface of the retina (Purves et al., 2001). Initially, the vitreous humor has a gel-like consistency, made up of collagen fibers, hyaluronic acid, and water; it adheres most strongly to the retina "around the vitreous base (ora serrata), at the optic disc margins, at [the] macula, and around peripheral blood vessels" (Ramovecchi et al., 2021). However, as one ages, the vitreous begins to liquify, degenerating from its gel phase into a water phase and the adhesion to the retina begins to weaken (Bond-Taylor et al., 2017). The liquefication of the vitreous humor can result in posterior vitreous detachment (PVD), which is when the vitreous suddenly separates from the retina (Ramovecchi et al., 2021).

Posterior vitreous detachment is a normal and physiologic part of aging; however, complications can result in retinal damage, such as retinal tears and/or retinal detachment. As previously mentioned, the vitreous adheres to the retina, and over time, naturally, the adherence begins to weaken. However, if, when the vitreous humor begins to collapse, it is still strongly attached to the retina, its weight will exert traction and result in a retinal tear, which can potentially progress into retinal detachment (Feltgen, Walter, 2014). According to the report written by Drs. Feltgen and Walter, "every fifth patient with posterior vitreous detachment develops a retinal hole" (2014). Therefore, it is crucial to see an ophthalmologist after experiencing common posterior vitreous detachment symptoms, such as "photopsia (flashes) and myodesopsia (or floaters [aggregated collagen fibers])," especially if the symptoms begin to worsen, as it can be a sign of retinal damage (Ramovecchi et al., 2021).

Ocular Trauma

Trauma to the ocular region can cause retinal detachment. The forceful impact to the eye results in the sudden compression and indentation of the eyeball and, when strong enough, can cause retinal breaks and/or retinal detachment (Wilians, 2021). According to studies performed by

Drs. Ghazi and Green, "about 15% of all retinal detachments are traumatic" (2002). In a past study, "seventy-seven patients developed retinal breaks following an episode of ocular contusion, and 65 (84.4%) of these developed rhegmatogenous retinal detachment" (Johnston, 1991). The form of retinal detachment that occurs is dependent on the type of trauma that took place, either blunt or penetrating. Generally, blunt trauma results in rhegmatogenous retinal detachment, and penetrating trauma results in tractional retinal detachment, with "blunt trauma represent[ing] about 70-85% of all traumatic retinal detachments" (Ghazi, Green, 2002).

In general, retinal detachment is fairly uncommon amongst children; however, when it does occur, the majority of detachments are caused by ocular trauma (Yasa et al., 2018). In fact, traumatic retinal detachment is actually more common among young individuals than adults (Ghazi, Green, 2002). However, as mentioned previously, rhegmatogenous retinal detachment occurs when the vitreous humor seeps through a retinal tear, pushing the retina away from its supporting tissues. In young individuals, the vitreous is still intact in its original gel-phase and actually provides a "sealing effect on retinal breaks." For a retinal detachment to occur, the trauma would have to also induce a traumatic vitreous syneresis (degeneration of the vitreous humor from its gel-phase into the water phase), thereby allowing the fluid to seep into the subretinal space and develop into retinal detachment (Ghazi, Green, 2002).

Myopia

In order "to obtain clear vision, the eye must accurately focus an image in space on the retina" (Fredrick, 2002). Refractive error is when a pair of eyes are unable to focus an image on the retina due to the shape of the cornea, aging of the lens, or the length of the eye. Myopia (nearsightedness) is a type of refractive error that is caused by "the cornea or lens curvature [being] too strong" or the eye being too long (axial myopia) (Fredrick, 2002). In normal eyes, the image falls precisely on the retina. However, in myopic eyes, the image is focused in front of the retina, causing far objects to appear blurry while objects up close are clear.

Myopic patients have an "increased risk of sight-threatening diseases, including retinal tears which may lead to a retinal detachment." This is due to the anatomical structure of myopic eyes. As mentioned previously, one cause of myopia is that the length of the eyeball increased, which is known as axial elongation. This excessive growth stretches out the retina and therefore makes it more "prone to peripheral retinal tears." Additionally, in myopic eyes, the vitreous humor is already degenerating, so it is "more likely to collapse and separate from the retina," thereby also increasing the risk of retinal tears (Williams, Hammond, 2019). In various study groups, it was found that "50% of all patients with rhegmatogenous retinal detachment were myopic" (Feltgen, Walter, 2014).

The measurement term used for refractive errors is diopters (D), and when referring to myopia, it is designated with a minus sign. "Mild myopia is 0 D to −1.50 D, moderate −1.50 D to −6.00 D, and high myopia −6.00 D or more" (Fredrick, 2002). The stage of myopia, whether mild, moderate, or high affects the chances of retinal detachment occurring, as Drs. Feltgen and Walter explain, "shortsightedness of up to -3.00 diopters (D) quadruples the risk of retinal detachment, and myopia of more than -3.00 D increases the danger of detachment tenfold" (2014). Furthermore, "the prevalence of myopia is increasing globally," and it is predicted that "by the year 2050, high myopia will affect 9.8% of the global population; a total of 938 million people" (Williams, Hammond, 2019). Therefore, it is important to ensure that myopic patients are well-informed of the risks and symptoms of retinal detachment. It is incumbent on the doctor to emphasize the importance of myopic patients taking certain necessary precautions, such as wearing protective eyewear during contact sports (Kwok et al., 2020).

Prior Eye Surgery

Light is transmitted and focused on the retina with the assistance of structures within the eyes, including the crystalline lens (Hejtmancik, Shiels, 2015). The lens needs to be transparent for an image to be planted clearly on the retina. Therefore, when opacification of the lens occurs, known as a cataract, it causes visual impairment (Davis, 2016) and decreases the quality of life. So, in order to re-acquire decent visual acuity, the cataract must be removed. According to Vision 2020, every year, approximately ten million cataract surgeries are performed worldwide. The majority of cataract extractions occur without complication; however, surgery, no matter the type, always poses a risk to the patient. Cataract surgery can potentially cause retinal detachment, and the risk of it occurring, specifically rhegmatogenous retinal detachment, is approximately 1/1000 (Feltgen, Walter, 2014).

Cataract surgery, along with being one of the most common procedures performed, can also be traced back to the earliest. In 1747, "the first true cataract extraction" was performed in a manner of extracapsular cataract extraction (ECCE), meaning that the lens capsule was left in place. In 1753, a new approach to cataract surgery was taken, known as intracapsular cataract extraction (ICCE),

where the entire lens (including the capsule) was removed. The modern-day approach to cataract surgery is a form of ECCE, known as phacoemulsification, where the lens is emulsified and aspirated through an ultrasound-driven needle. However, although this procedure is considered the safest and most preferred method of cataract surgery, retinal detachment risks are still involved (Davis, 2016).

In a population-based study, it was found that cataract extraction increases the risk of posterior vitreous detachment (Erie et al., 2006). The surgery "accelerates the liquification of the vitreous humor," enabling it to collapse and exert traction on the retina with the potential to progress into a retinal detachment (Feltgen, Walter, 2014). The study also discovered that certain risk factors, such as "myopia, increased axial length, and posterior capsular tear at surgery significantly increased the risk of retinal detachment." Specifically, with regard to posterior capsular tears, it was found that "six of nine cataract extractions" that underwent this complication "had a retinal detachment within 1 year of surgery" (Erie et al., 2006). Furthermore, it was found that the danger of retinal detachment "grows as the postoperative interval increases" (Feltgen, Walter, 2014). The probability of retinal detachment occurring "increased from 0.27% at 1 year after cataract extraction to 1.79% at 20 years" (Erie et al., 2006).

Conclusion

Retinal detachment is considered an ocular emergency, and if not treated properly and immediately, can result in blindness. Patients who possess any high-risk factors for retinal detachment should routinely see an ophthalmologist. The doctor's responsibility is to inform these patients of the necessary precautions to take and the signs and symptoms of retinal detachment. It is also crucial to express the time-sensitive aspect of this emergency and how immediately after experiencing any symptoms, patients need to see their ophthalmologist.

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