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Influencing Factors in Dry Eye Post Cataract Surgery (Phacoemulsification): A Literature Review

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Abstract

With the increase in life expectancy, the number of elderly people worldwide is increasing—no wonder the incidence of cataracts is growing worldwide and in Indonesia. Definitive cataract therapy is by operative action. The surgical technique that is increasingly being done is the phacoemulsification technique. This technique is said to have the fastest recovery time with minimal side effects, but some studies stated that the incidence of dry eye post-phacoemulsification was relatively high. This study wants to find out what can affect the incidence of dry eye post-phacoemulsification. From a literature search, several things that affect the incidence of dry eye post-phacoemulsification before surgery are age, systemic disorders in the form of diabetes mellitus, and duration of smoking habits. Things that affect intraoperatively include incision wounds in the cornea, topical eye drops used, whether they contain the preservative benzalkonium chloride, heat generated both from the light of the microscope lamp and the phacoemulsification tooltip, and the duration of surgery. Symptoms of dry eyes that arise can appear immediately after surgery up to a maximum of 7 days after surgery, symptoms diminish over time. The condition of the eyes back to normal is achieved within 12 weeks. When giving mixed eye drops of antibiotics and steroids postoperatively, phacoemulsification will help reduce inflammatory reactions and the incidence of dry eye post-phacoemulsification.

Keywords: Cataract, Dry eye post cataract surgery, Phacoemulsification.

Introduction

Aging is a process that cannot be prevented. The longer life expectancy increases, the number of elderly people also increases. The aging process in the lens, known as cataracts, will be increasingly found. Blindness caused by cataracts is reversible blindness, so if cataracts are handled properly, the quality of life of the elderly will improve. It will not be a burden for their families.^[1] The definition of blindness according to WHO is a vision of $<3/60$ in the best eye with the best correction.^[2] The World Health Organization (WHO) estimates that in 2018 there were 1.3 billion people who experienced visual impairment, most were cases of uncorrected refraction (42%), and the second most were cataracts (33%). The first cause of blindness worldwide is cataracts, with a prevalence of 51%^[3], and the prevalence of cataracts in Indonesia is 1.4%.^[2]

Risk factors for cataracts include age, most of which are suffered by someone aged >50 years. Other risk factors are female sex, metabolic diseases such as diabetes mellitus, hypertension, genetic factors, smoking habits, ultraviolet exposure, etc.^[2,4] Metabolic diseases in cataract risk factors are commonly experienced by the elderly, where if they experience it, cataracts can appear earlier, further increasing the number of cataract cases. The treatment for senile cataracts is cataract surgery, one of which is the phacoemulsification method that has been commonly done.^[5]

Cataract surgery causes several changes both in the cornea and on the surface of the eyeball, so changes in corneal sensitivity also increase the risk of dry eye symptoms. Some studies stated there is a relationship between phacoemulsification surgery with dry eye symptoms. Symptoms of dry eyes can appear from the first day to 1 week postoperatively.^[5] This study wants to discuss what can affect the incidence of dry eye after cataract surgery (dry eye post phacoemulsification).

Methods

Several studies clinically prove the incidence of dry eye post phacoemulsification. In this study, the author wants to discuss what can affect both preoperative conditions and during surgery that can cause this. The author will combine information from existing journals and then try to conclude. The information obtained is expected to help reduce the incidence of dry eye post-phacoemulsification.

Discussion

Cataract Therapy

Cataract Therapy, the definitive therapy for cataracts is surgery. According to some studies, cataracts that do not need surgery can use vitamins C and E to slow the growth of cataracts but still cannot remove existing cataracts. Indications for cataract surgery are sharp vision that interferes with daily activities. Medical indications for cataract surgery include phagocytic glaucoma, phacomorphic glaucoma, uveitis, lens dislocation, and mature cataracts.^[2] There are four types of cataract surgery. The first type is Intracapsular Cataract Extraction (ICCE), which removes the lens and capsule. This procedure has been largely abandoned, the lack of this technique is a large wound that requires long healing, causing postoperative astigmatism, cystoid macular edema (CME), and retinal detachment. However, this technique is still an option in the case of lens subluxations as well as very dense lenses. The second type is Extra Capsular Cataract Extraction (ECCE), this procedure removes the lens cortex and nucleus by making a hole in the anterior lens capsule, then leaving the capsule sac as a place to place the Intra Ocular Lens (IOL). This action is more commonly done than ICCE. Although the size of the wound that arises is still quite wide, it has several advantages. The advantages of the posterior capsule of the lens are that it can reduce the risk of CME and retinal detachment and prevent vitreous attachment to the lens. The third type is Small Incision Cataract Surgery (SICS). This technique removes the lens either intact or split first. This technique has a smaller wound width, only about 7-8 mm, and almost does not require stitches so that wound healing becomes faster and the risk of astigmatism after the procedure is also smaller. This technique is popular in developing countries because it does not require expensive equipment such as phacoemulsification techniques, but the results are almost equivalent to phacoemulsification techniques. The last type, the fourth, is phacoemulsification. This technique requires an ultrasonically powered tipping device to split the lens nucleus into several smaller parts to be aspirated through a small incision wound (2-3 mm). This small wound certainly accelerates healing and does not cause postoperative astigmatism, and this is an advantage of this technique. This advantage has made this technique increasingly popular lately.^[2]

Risk Factors of Dry Eye Pre-Operative

A. Age

Dry eye syndrome is prevalent in the elderly, occurs in about 5-30% of the elderly, and is more common in women than men. It was 8.4% in subjects younger than 60, 15% in subjects aged 70-79, and 20% in those older than 80. A large epidemiological study from the Women's Health Study and Physician's Health noted that the prevalence of dry eye increases in women and men every five years after age 50. The ages of menopause and the elderly at risk of dry eyes are

by the age of the appearance of cataracts. In patients with cataracts, physiologically elderly generally, there is a decrease in production of the lacrimal gland, this will increase the osmolarity of tears to hyperosmolarity, referring to dry eye.^[6,7,8]

In women who experience menopause, there will be a decrease in the production of the hormone estrogen, this will decrease the work of the meibomian glands in producing the lipid layer of tears.^[9] The lipid layer is the outermost layer of the tear layer, lipids prevent the tear layer underneath from quickly evaporating, so if the lipid layer decreases, the tear layer will evaporate faster, thereby increasing the risk of dry eye in women who have menopause. If dry eye syndrome appears before cataract surgery, it increases the risk of dry eye post-phacoemulsification.^[10]

B. Diabetes Mellitus

Hyperglycemia conditions in diabetes mellitus will cause an increase in tear osmolarity to stimulate the release of IL, 1, MMP-9, and proteins that play a role in the dysfunction of the Lacrimal Function Unit (UFL) in diabetes mellitus dry eye syndrome, namely ALS2CL, PLXNA1, and lacritin. Increased osmolarity of tears means thickening of tears, this indicates decreased water content in tears, both due to reduced production and excessive evaporation. This is also called dry eye.^[11]

High sugar levels in the blood can accelerate the growth of cataracts, primarily if the condition of diabetes mellitus is not controlled for a long time.^[12] So, it is clear that the condition of diabetes mellitus increases the risk of dry eye in patients with diabetes mellitus and cataracts who undergo cataract surgery. Of course, this increases the occurrence of dry eye post-phacoemulsification.

C. Smoking

Exposure of cigarette smoke released from the mouth and the results of burning tobacco causes direct eye irritation. This is because most of the active substances in cigarettes are present in the air when burnt.^[13] The study of Thomas J et al. (2012)^[14], also supports this result, which reported that smoking causes a bad effect on the precorneal tear layer, thereby, leading to dry eyes. Exposure to smoke irritates the eyes, which causes inflammation and damage to the corneal epithelial cells. This leads to the loss of the mucous layer of tears resulting in instability of its layer. Inflammation is the activation of innate pathways on ocular surface cells, such as cytokines produced by T helper (Th). Cytokines are produced by infiltrating Th cells, thereby altering its normal balance and causing pathological epithelium on the eye surface, and this can lead to dry eye.

In research, Adeliani^[15] stated that there is a relationship between a long history of smoking and the appearance of dry eye symptoms. This says that patients who will undergo cataract surgery and who have a history of smoking for a long time can increase the risk of dry eye post-phacoemulsification.

Risk Factors of Dry Eye Intra Operative

Rajashekarreddy et al. stated that a significant relationship exists between the incidence of dry eye in patients after cataract surgery with a value of $p = 0.001$. Some causes are claimed to be responsible, but it is stated that the main cause of this occurrence is due to changes in the surface of the eyeball after cataract surgery after corneal incision action.

During surgery, a corneal incision will be performed, this action will break the nerves on the cornea's surface, and when healing, there will be a decrease in corneal sensation. Sensation in the cornea is needed in the tear production reflex so that if the sensation decreases, the stimulation for tear production will also decrease, causing dry eye.^[16] The cornea is the organ with the most nerve fibers, branches of the Trigeminal nerve. The sensory nerve originates in the nasociliary branch of the nerve ophthalmic nerve and the ciliary nerve longus. Corneal nerve fibers spread to the stromal and subepithelial plexuses of the limbus. Large nerve fibers run from the 9 o'clock and 3 o'clock positions. These sensory nerve fibers, through the parasympathetic reflex, regulate tear production. In phacoemulsification cataract surgery, after an incision in the cornea, this causes corneal nerve fibers to be severed and interferes with the parasympathetic reflex of tear production, which can cause dry eye post-phacoemulsification.^[8,17,18]

Before the operation, Local anesthesia will use 2% pantocain eye drops. This liquid is quite concentrated and causes a stinging sensation when dripped. The pain will last for about 1 minute then the pain will disappear, indicating that the anesthesia has worked. Mydrical drip and topical anesthesia in preparation for surgery will also increase inflammatory mediators. Topical eye drops containing the preservative benzalkonium chloride can trigger corneal and conjunctival epithelial cell toxicity. This disrupts tear stability and reduces the number of Goblet cells that produce mucin on the surface of the conjunctiva. These factors can cause complaints of dry eyes in patients with post-cataract surgery.^[16,18,19]

The operation uses a microscope so the operator can see clearly into the eyeball. Specific magnification and bright enough lighting are needed. Light from a microscope lamp will produce heat. The operation lasts approximately 30 minutes. Exposure to heat from this microscope lamp can cause damage to the corneal epithelium. This can also disrupt excitatory tear production.^[16]

The phacoemulsification operation technique uses an ultrasonically powered tipping device, where this power generates heat. The longer the duration of surgery, the longer the eyes are exposed to heat from the tool.^[20] The reduction in Goblet cells correlated with the length of time of this operation did not even improve after three months. Therefore, the length of surgery time also influences the incidence of dry eyes postoperatively.^[18]

Dry Eye Post Phacoemulsification

Symptoms and signs of dry eyes may appear immediately after surgery and peak at seven days postoperatively but then improve over time.^[17,21] In the study, Yuwanda V et al.^[8] stated a significant difference in dry eye patients before and one month after phacoemulsification surgery.

In the study, Gupta M et al.^[21] stated that dry eye values returned to the preoperative state after 12 weeks of surgery. Research conducted by Adiwardhani A et al.^[10] gave eye drops a mixture of antibiotics and steroids after phacoemulsification surgery. These eye drops will help reduce inflammatory reactions that occur. This is thought to be the reason in the study, the incidence of dry eyes postoperatively is smaller than preoperative. The study found a significant relationship between the incidence of preoperative dry eye and 1-week postoperative phacoemulsification with $p = 0.03$.

Conclusions

From a literature search, several things that generally affect the incidence of dry eye post-phacoemulsification before surgery are age, systemic disorders in the form of diabetes mellitus, and the duration of smoking. Matters that affect intraoperatively include incision wounds in the cornea, topical eye drops used, whether they contain the preservative benzalkonium chloride, heat generated both from the light of the microscope lamp and from the tips of ultrasonically powered phacoemulsification tools, and the duration of surgery. Symptoms of dry eyes that arise can appear immediately after surgery up to a maximum of 7 days after surgery, symptoms diminish over time. Eye condition Return as before achieved within 12 weeks or three months. In one study, it was found that giving eye drops mixed with antibiotics and steroids after phacoemulsification surgery will help reduce inflammatory reactions that occur and can reduce the incidence of dry eye post-phacoemulsification.

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