Dry Eye Disease After Cataract Surgery: Study of Its Determinants and Risk Factors

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Abstract-
Objective: The purpose of our research is to determine the prevalence and determinants of dry eyes in participants who undergo cataract surgery.
Methods: Liaquat University of Medical & Health Sciences Jamshoro conducted the study for six months. The study involved 150 subjects with senile cataracts and preexisting dry eye syndrome. The medical histories and ocular conditions of the subjects were evaluated in order to determine if they contributed to dry eye.
Results: Participants' mean age was 60.36±9.88 years and most (91, 60%) were male. During the first week after surgery, as a result of Schirmer's tests, the values ranged from 11 to 36 mm, and after a month, the values ranged from 7 to 25 mm. Schirmer's test was used in preoperative clinical evaluation to assess dry eye. According to the TBUT data, the mean was 14.52±1.92 (range 11-19 s). A significant increase in dry eye risk at 1 week was seen in the phacoemulsification group with exposure times >15 minutes (p=0.007).
Conclusion: A high number of patients develop dry eye after cataract surgery, regardless of demographics and anthropometric, surgical type, microscope exposure time, and energy input. As a transient condition, this dryness subsided in one month, eventually returning to normal.
Keywords: Cataract surgery, dry eye disease, risk factors

I. INTRODUCTION

According to our definition, dry eye disease (DED) is a condition caused by excessive tear evaporation or a reduction in tear production. It causes visual dysfunction and discomfort to the interpalpebral ocular surface.[1] Besides discomfort, visual disturbances, and the instability of the tear film, there are several factors that contribute to dry eye development.[2] It is complemented by an increase in tear osmolality and inflammation of the surface of the eye. Several factors and causes, including old age, gender, connective tissue disorders, metabolic syndromes, including diabetes and hypertension, and contact lens use, have been associated with dry eye syndrome. Blepharitis, chronic conjunctivitis, meibomitis, pterygium, oral contraceptives, antidepressants, antihistamines, anticholinergics, antidepressants, and topical eye drops that contain preservatives are ocular syndromes.[3–5] Apart from conventional dry eye syndrome risk factors, some surgical processes involving the anterior segment have also been shown to increase dry eye symptoms or worsen existing ones The laser-assisted in situ keratomileusis procedure, as well as photo-refractive keratectomy and cataract surgery, are all types of eye surgery.[6–8] I have shown that when the cornea is denervated because of cataract surgery; it is less likely to heal epithelial wounds, to increase epithelial permeability, Reduced epithelial metabolic activity because of the loss of cytoskeletal structures. Several factors have been shown to affect the risk of dry eye disease following cataract surgery, including the process used,[9] ophthalmic solution used,[10] intraoperative medications, coexisting systemic diseases,[11] light exposure under an operating microscope, cumulative dissipated energy (CDE),[12] and the time since surgery.[13] A variety of factors can contribute to dry eye disease subsequent cataract surgery, including the type of surgery,[9] intraoperative exposure,[12] and phacoemulsification energy used, so it is crucial to perform a thorough risk estimate before either phacoemulsification or small-incision cataract surgery (SICS) is performed.[12] The aim of our research is to determine the pervasiveness and determinants of dry eyes in participants who undergo cataract surgery.

II. MATERIAL AND METHODS

The study was carried out for six months at Liaquat University of Medical & Health Sciences Jamshoro. The study involved 150 subjects with senile cataracts and preexisting dry eye syndrome. The medical histories and ocular conditions of the subjects were evaluated in order to determine if they contributed to dry eye. We excluded those who failed to give consent, did not provide informed consent, or were lost to follow up.
The best corrected visual acuity and intraocular pressure of each subject were measured using a Snellen chart and a Goldmann applanation tonometer. Indirect ophthalmoscopy was used to examine the fundus after a detailed slit-lamp examination. An Ocular Surface Disease Index (OSDI), Schirmer's test, tear break-up time test, lissamine green stained cornea and conjunctiva, and Schirmer's test were all performed to rule out dry eye. To measure basal and reflex tear secretions, according to Schirmer, a specific test strip was prepared from Whatman filter paper no. 41 was used that measured 40´5 mm across and had a 0 to 35 mm marking. Schirmer's test is graded according to the

amount of wetting on the strip: Normal >10 mm "grade 0", Mild 5-10 mm "grade 1", Moderate 3-4 mm "grade 2", Severe 0-2 mm "grade 3".

A TBUT test was performed to assess tears film solidity and Meibomian gland dysfunction, and classifying was based on how long it took for a dry spot to appear after the last blink. TBUT abnormal was <10s and graded as Normal >10s grade 0, Moderate 3.1-6s grade 2, Fair 6.1-10s, grade 1, Poor <3s grade 3.

In order to evaluate whether the ocular surface contained dead and devitalized cells, Lissamine Green staining was performed. A total of four dry eye grades were determined, no dry eye 0, mild 1, moderate 2, and severe 3. Dry eye is measured using the OSDI, a 12-item test based on 0 to 100, where higher scores indicate worse symptoms. In order to separate normal individual from patients with dry eye disease, the index demonstrates sensitivity and specificity. Based on the grading criteria: 0-12 were normal ranges, 13-22 were mild ranges, 23-32 were moderate ranges, and 33-100 were severe ranges.

A number of factors were considered in our study, including pre-anesthetic medications, incision shapes, cataract surgery type (phacoemulsification or SICS), microscope exposure, modification of ocular surface tissue by CDE, as well as medications used intraoperatively and postoperatively. All cases were treated with the same pre-anesthetic, intraoperative, postoperative medications (a combination of antibiotics and steroids, nonsteroidal anti-inflammatory and intraocular pressure-lowering topical eye drops instilled at the same frequency from the same pharmaceutical brands), and operating surgeon. We followed up with the patients one week after their surgery and one month later. In both instances, all dry eye parameters were reevaluated. Institutional ethics committees approved the study. Written consent and informed consent were obtained from all subjects.

Statistical Analysis: In order to carry out statistical analyses, SPSS version 22.0 was used. We presented the values as a number of percentages (%) and as a mean ± standard deviation. It is statistically significant if there is a P-value <0.05, and its significance is high if there is a P-value <0.001.

III. RESULTS

The largest age group among the 150 evaluated participants was 51-60 years 54 (36.0%). Next were 50 (33.33%) individuals in the 41-50 years' group and 380 (25.33%) individuals in the ≤40-year group and 9 (6.0%) participants were present in the age group >60 years. The mean age of the participants was 60.36±9.88 years and most (91, 60%) were male.

It was found that 129 participants (86.0%) were from rural areas, while only 21 participants (14.0%) belonged to urban areas. occupation largest group was Homemakers Fifty-three (35.33%) participants, while 41 (27.3%) participants by farmers, twenty-one (14.0%) participants were skilled laborers, 20 (13.33%) participants were teachers, and 15 (10%) participants were shopkeepers.

Nutritional status was classified as normal in 143 participants (95.3%) according to body mass index (BMI), with 7 (5.33%) classified as overweight (25.1-30 kg/m2). None of the participant were found in underweight (<18.5 kg/m2) and no any patient were present in obese (>30 kg/m2) (Table 1).

The majority of participants experienced photophobia 56.0%, while 50.6% patients had itching, 46.0% patients had watering, where as 45.3% patients had burning sensation, 42% patients had eye pain, while 39.3% patients had redness of the eyes, 36.6% patients had lid heaviness, 28% patients had foreign body sensation, and 27.3% patients discharge (Table 1).

Schirmer's test was used in preoperative clinical evaluation to assess dry eye. The mean Schirmer's test value was 28.24±4.39 mm, with a range of 16 to 36 mm. According to the TBUT data, the mean was 14.52±1.92 (range 11-19 s). It was found that one in 99 cases (66.0%) and two in 51 cases (34.0%) showed Lissamine green staining. A mean OSDI value ranged from 1 to 12 of 6.59±2.81 was found among the patients. As per the study's inclusion criteria, none of the patients had dry eyes when they were enrolled (Table 2).

According to Schirmer, his test values ranged from 11 to 36 mm for the first week after surgery and 7-25 mm for the first month following surgery. At week one and month one of follow-up, the mean TBUT was 14.18±2.48 and 9.75±2.31 s, respectively, and the lissamine green staining score was 3 in 84 (56.0%) and 1 in 84 (56.0%) individuals. At one week, OSDI values were between 1 and 31 (mean 12.78±7.56), and in one month, they were between 11 and 34 (mean 26.86±5.25) (Table 2).

Among the patients who had cataract surgery, 53.3% used the phacoemulsification technique, and 46.6% used SICS. According to SICS, 92.8% and 27.1% were reported respectively at the corresponding time points, 89.3% and 15.0% of those in the phacoemulsification group had dry eyes after one week and one month, respectively. It was not statistically significant (p>0.05) whether dry eye incidence was higher following SICS or phacoemulsification. (Table 3).

According to our analysis, most our patients 81 (54%) used microscopes for from 10 to 15 minutes at most, followed by 42 (28%) for 16 to 20 minutes, 14 (9.3%) for 21-25 minutes, and 13 (8.6%) for 26-30 minutes. Among those undergoing phacoemulsification, the majority 66 (82.5%) had microscope exposure times lasting 10 to 15 minutes, followed by 16 to 20 minutes 12 (15%), and 21 to 25 minutes 2 (2.5%). A majority of microscope exposure times occurred between 16 to 20 minutes 30 (42.8%), followed by 10-15 minutes 16 (22.8%), 21-25 minutes and 26-30 minutes 10 (12.1%) in the SICS group.

A significant association wasn't found between microscope exposure time and dry eyes at 1 week or 1 month postoperatively, whether it was evaluated overall or among SICS patients. A significant increase in dry eye risk at 1 week was seen in the phacoemulsification group with exposure times >15 minutes (P-value 0.006). (Table 4)

Table 1: Demographic profile of the participants (n=150)

Variables	Frequency	Percentage
Age, years		
≤ 40	38	25.3%
41-50	50	33.3%
51-60	54	36.0%
>60	9	6.0%

Mean age ± SD (range)	60.36±9.88 (41-80)	
Gender		
Male	91	60.6%
Female	59	39.33%
Place of residence		
Rural	129	86.0%
Urban	21	14.0%
Profession		
Homemaker	53	35.3%
Farmer	41	27.3%
Skilled laborer	21	14.0%
Teacher	20	13.3%
Shopkeeper	15	10.0%
Body mass index, kg/m^2		
18.5-25.0	143	95.3%
25.1-30	7	5.3%
Symptoms		
Foreign body sensation	42	28.0%
Burning sensation	68	45.3%
Discharge from eye	41	27.3%
Itching	76	50.6%
Lid heaviness	55	36.6%
Photophobia	84	56.0%
Redness of eyes	59	39.3%
Eye pain	63	42.0%
Watering	69	46.0%

Table 2. A preoperative and postoperative clinical assessment.

	Preoperative n (%)	postoperative 1 week n (%)	postoperative 1 month n (%)
Schirmer's test, mean ± SD (range) Normal (≥15 mm) Mild (9 to 14 mm) Moderate (4 to 8 mm) Severe (<4 mm)	28.24±4.39 (16 to 36) 150 (100%) - - -	25.62±6.33 (11-36) 125 (83.3%) 25 (16.6%) - -	13.92±2.96 (7-25) 19 (12.6%) 128 (85.3%) 3 (2.0%) -
TBUT normal (>10 s) fair (6.1 to 10 s) moderate (3.1 to 6 s) poor (<3 s)	14.52±1.92 (11-19) 150 (100%) - - -	14.18±2.48 (7-19) 121 (80.6%) 29 (19.3%) - -	9.75±2.31 (5-15) 46 (30.6%) 98 (65.3%) 6 (4.0%) -
Lissamine green staining of cornea/conjunctiva score 1 2 3 4	1.35±0.49 (1-2) 99 (66.0%) 51 (34.0%) - -	3.12±0.81 (1-4) 4 (2.6%) 20 (13.3%) 84 (56.0%) 46 (28.0%)	1.70±0.78 (1-3) 84 (56.0%) 42 (28.0%) 24 (16.0%) -
Ocular Surface Disease Index Normal (0-12) Mild (1 -22) Moderate (23-32) Severe (3 -100)	6.59±2.81 (1-13) 150 (100%) - - -	12.78±7.56 (1-32) 119 (79.3%) 29 (19.3%) 2 (1.3%) -	26.86±5.25 (11-34) 12 (8.0%) 129 (86.0%) 9 (6.0%) -

Table 3. Comparison of dry eye incidence in the phacoemulsification and SICS.

Surgical technique	Frequency (%)	Dry eye disease at week 1	Dry eye disease at month 1
Phacoemulsification	80 (53.3%)	134 (89.3%)	12 (15.0%)
small-incision cataract surgery	70 (46.6%)	65 (92.8%)	19 (27.1%)
P-value		p=0.351	p=0.124

Table 4. The association between microscope exposure time and dry eye after cataract surgery for 1 week and 1 month.

Time	Frequency	Dry eye disease at week 1	Dry eye disease at month 1
Total (n=150)			
10-15 min	81	74 (91.3%)	16 (19.7%)
16-20 min	42	40 (95.2%)	10 (23.8%)
21-25 min	14	13 (92.8%)	3 (21.4%)
26-30 min	13	10 (76.9%)	3 (23.0%)
P-value		p=0.503	p=0.862
Phacoemulsification (n=80)			
10-15 min	66	59 (89.3%)	10 (15.1%)
16-20 min	12	12 (100%)	2 (16.6%)
21-25 min	2	0	0
26-30 min	-	-	-
P-value		p=0.006	p=0.732
Small-incision cataract surgery (n=70)			
10-15 min	16	16 (100%)	7 (43.7%)
16-20 min	30	28 (93.3%)	8 (26.6%)
21-25 min	12	12 (100%)	3 (25.0%)
26-30 min	12	10 (83.3%)	3 (25.0%)
P-value		p=0.125	p=0.502

IV. DISCUSSION

Ophthalmology's most common procedure is cataract surgery. Any surgery may result in postoperative complications.[17] In addition to these complications, patients frequently complain about grittiness, foreign body sensation, and burning sensations related with dry eye disease. There is a wide range of occurrence of dry eye following cataract surgery, ranging from 9.8 to 96.6.[18–36] It is known that participants who undergo cataract surgery are more likely to experience dry eye because of several issues, comprising the type of procedure, besides SICIS/phacoemulsification, intraoperative and postoperative medications, coexisting systemic disorders, time spent under the operating microscope during phacoemulsification, and duration since surgery, other factors should be considered. It has not been

possible to identify the cause of dry eyes for each of them individually. We studied 150 participants undergoing unilateral cataract surgery to determine the pervasiveness and determinants of dry eye. Dodia et al.,[37] reported the mean age of the participants in their study was 60.35 years, which corresponds to the mean age of the participants in this study, which is 60.36±9.88 years. Although most of the study participants were male (60.66%), this is at odds with prior studies in which most patients were female.[38,39] Females are more likely than males to experience age-related cataracts because of estrogen changes related to menopause.[40,41] Most studies did not include information on the domicile and occupation of patients. Our study found that most dominant occupations are homemakers (35.33%) and farmers (27.3%). The place of residence, occupation, and sanitary conditions could all influence the prevalence of a dry eye at 1 months after patients resume their daily activities.[42–44] We assessed the impact of different surgery on dry eye incidence by comparing phacoemulsification and SICS. In our study, 53.3% of the operations were phacoemulsification's, and 46.6% were SICS. SICS and phacoemulsification cases have rarely been included in studies.[45,46] We considered OSDI-evaluated dry eye as representative of the dry eye for this study. Our study found that 93.3% of participants had dry eyes. Depending on various determinants and methods of evaluating the dry eye, the pervasiveness of the dry eye varies substantially among studies. According to the present study, TBUT identified dry eyes in 69.4% of participants, while OSDI detected them in 92.2%. Different studies have found varying incidences of dry eyes. Following up on patients for 7 days, 30 days, and 90 days was the subject of a study conducted by Kasetsuwan et al.[47] According to their findings, dry eye severity peaked 7 days postoperatively. According to Venugopal et al.,[48] 58.8% of their study population had revised data between two and six weeks after surgery, and 41.2% had revised data at two to four years. They observed the peak incidence of a dry eye on day one after surgery, according to Dodia et al.[37] Cumulative dissipated energy (CDE) was not correlated with dry eye incidence in patients who underwent phacoemulsification for 1 week or 1 month in this research. There was no significant change among the phacoemulsification and SICS groups, as observed by Sahu et al.,[13] Rizvi et al.,[45] and Sengupta and Banerj.,[42] the present study also found similar results. According to Yu et al.,[34] the type of surgery does not affect dry eye prevalence. The dry eye tests performed in the present study revealed mild dry eye in 85% of OSDI cases and Schirmer's cases, and moderate dry eye in 65% of TBUT cases. The results of various previous studies have also shown that mild dry eye is the most prevalent (53.32% reported by Venugopa et al.,[48] and 58.06% by Manjula et al.,[51]) while severe dry eye is the most prevalent Jayashree et al.[52]

The severity of dry eye after cataract surgery is highest seven days after cataract surgery, according to Kasetsuwan et al.,[18] 's OSDI questionnaire and clinical testing results. However, the condition gradually improves between 1 and 3 months. As perceived in the current study, despite improvement at one month, preoperative values weren't reached until two months after surgery. Most researchers believe cataract surgery will only have a transient impact on the patient, and will recover within three to six months.[37,38,45] According to the present study, dry eye follows cataract surgery with a high incidence. According to Sutu et al.,[19] this can cause reduced corneal sensitivity and reduced tear production.[19] Excessive inflammatory responses, resulting in neutrophil conscription and macrophage recruitment, in addition to producing free radicals, enzymes that degrade proteins, and cyclooxygenases, plays an important role in dry eye syndrome development. Anesthetics, eye drops containing preservatives, and eye drops used pre- and postoperatively also cause inflammation.

V. CONCLUSION

In the present study, dry eyes were quite common following cataract surgery, regardless of a variety of variables, including demographics and anthropometric, surgical procedure type, time spent under the microscope and the amount of energy employed. The trend at the end of a month showed that the dryness was transitory and normalized. The follow-up period for our study was brief, so it was not possible to determine when all patients returned to their normal states. We recommend future studies that focus on assessing the time required to reach a normal state after a long-term follow-up period. In addition, it is crucial to investigate the long-term effects of cataract surgery on residual dry eye.

Patients' satisfaction with post-cataract surgery is significantly affected by dry eyes, despite excellent visual recovery. After cataract surgery, dry eye is an extremely common problem. The use of lubricating agents to provide symptomatic relief and reduce dry eye complications after surgery is therefore recommended for 2 to 3 months following surgery.

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