Relationship of cataract surgery and Diabetic retinopathy progression patients in Dhaka: Case-control study

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Abstract

Background: *Both Cataract and Diabetic retinopathy (DR) are the leading causes of blindness worldwide, which is aggravated by the fact that diabetics have an increased risk of developing cataracts. Bangladesh has a substantial burden of diabetic retinopathy disease and several health system challenges that make the regular deployment of diabetic retinopathy screening services difficult.*

Objective: *The objective of the study is to find a co-relationship between cataract surgery and the progression of diabetic retinopathy among patients in Dhaka.*

Methods and materials: *A case-control study of 36 type 2 diabetes patients who had cataract surgery performed by a single consultant surgeon. Preoperatively and 12 months postoperatively, the progression of diabetic retinopathy in the operated eye and the unoperated eye was evaluated.*

Results: *Individuals who had cataract surgery were 60±9.34 years old. At their preoperative evaluation, 17 patients (47.2%) were getting oral hypoglycemic, and 12 patients (33.3%) were receiving insulin. In contrast to the other 11 eyes, six of the operated eyes had PRP for proliferative retinopathy before cataract surgery. At the time of surgery, high-risk non-proliferative retinopathy (classified moderately severe or severe by ETDRS criteria) was discovered in 10 operated eyes and eight fellow eyes. Patients with progressing retinopathy had higher mean HbA1C values than patients whose retinopathy was stable Operative Eye (OE), p=0.001, None Operative Eye (NOE) p=0.000). Age is also a factor where the progression of DR for cataract patients increased in both OE and NOE (OE p=0.000, NOE p=0.003). In comparison, patients who required insulin substantially developed retinopathy progression in both eyes postoperatively than the patients who did not require insulin treatment (OE p=0.023, NOE p=0.027).*

Conclusion: *Any trauma like cataract operation DR as inflammation deteriorates vascular changes in the retina. So strict control of DM as well as proper post-operative management to avoid Ocular inflammation is crucial.*

Keywords: *Diabetic retinopathy, Cataract, non-proliferative diabetic retinopathy (NPDR)*

Introduction

Cataracts and diabetic retinopathy (DR) are the primary causes of blindness in the world, which is exacerbated by the fact that diabetic people have a higher chance of getting cataracts.[1-3] Consequently, many diabetic people also develop cataracts and DR. The prevalence of obesity, urbanization, aging, sedentary lifestyles, and population expansion all contribute to an increase in diabetes mellitus occurrences. In 2000, it was projected that 2.8% of people worldwide had diabetes; by 2030, that number is predicted to rise to 4.4%. According to projections, there will be 366 million persons with diabetes mellitus

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globally by 2030, up from 171 million in 2000 [4]. Cataracts continue to be the largest cause of blindness on a global scale, impacting around 18 million people [5].

It is believed that diabetic individuals get up to 20% of all cataract surgeries [6]. In older-onset diabetes patients, cataracts are the most frequent cause of visual impairment, and cataract surgery is very prevalent, according to epidemiologic research [7]. The results of cataract surgery have largely improved, although diabetic patients may not always have the same positive results. According to certain research, having cataract surgery may have side effects such as retinopathy progression, vitreous hemorrhage, iris neovascularization, and reduced or lost vision [8,9].

Due to hyperglycemia and damaged blood-aqueous or blood-retina barriers, cataracts may appear sooner in life and may be more common in diabetic people [10]. Breakdown of these barriers may also increase postoperative inflammation after cataract surgery, whether it be phacoemulsification or extra-capsular cataract extraction. This vicious cycle may trigger or hasten the advancement of DR [11]. As a result, the connection between cataract development, DR advancement, and associated risk factors has been the subject of several investigations. Higher HbA1C, having diabetes for a longer period, using insulin, and having macular edema were all found by Henricsson et al. as risk factors for DR development after cataract removal [12].

Twelve months after phacoemulsification, Hong et al. observed that the rate of development of DR almost doubled. However, phacoemulsification was associated with slower advancement than intra-capsular and extra-capsular cataract excision (ECCE) [13]. In a study of paired eyes, Jaffe et al. discovered that non-proliferative diabetic retinopathy (NPDR) advanced in 7 of 19 eyes after ECCE, but none progressed in the opposite eye over the 18-month follow-up period without surgery [14].

Bangladesh exhibits a significant burden of diabetic retinopathy illness and a variety of health system issues that make the regular deployment of diabetic retinopathy screening services challenging. Approximately 8.4% of Bangladesh's population had diabetes in 2017, according to data from the International Diabetic Federation, placing Bangladesh in the top 10 nations with the highest prevalence of the disease globally [15]. 15.8% of people had retinopathy and diabetes at the same time, and the majority (40.8%) had been ill for five to less than ten years [16]. The prevalence of cataracts is 19.87%, according to a study by Hossain et al [17]. However, there is no study on the correlation between cataracts and DR.

Objective

The study's objective is to find a co-relationship between cataract surgery and the progression of diabetic retinopathy patients in Dhaka.

Methods Nd Materials

A case-control study of 36 type 2 diabetes patients who had cataract surgery performed by a single consultant surgeon. Preoperatively and 12 months postoperatively from January 2021 to December 2021, the progression of diabetic retinopathy in the operated eye and the un-operated eye was evaluated, a consultant surgeon prospectively contacted and invited all patients with type 2 diabetes who had cataract surgery to take part in the trial conducted at Islamia Eye and Laser Center. The case group included immature cataracts with diabetic retinopathy in the operative eye. The control group included immature cataracts with diabetic retinopathy in the non-operative eye.

Patients were disqualified from the trial if the preoperative fundal examination determined that the retinopathy in the two eyes was severely asymmetrical—defined as a difference of more than one level on the Early Treatment Diabetic Retinopathy Study (ETDRS) grading scale[18]. These standards led to the inclusion of 43 patients, 36 of whom gave their permission to participate in the research. According to current departmental procedures, every patient who needed or wanted cataract surgery in the other eye was listed. Up to

the second eye operation, these patients were still being monitored and were part of the major study of retinopathy progression. The data related to these patients were then examined independently. Under general anesthesia, all patients had standard phacoemulsification cataract surgery. In the study's patient population, there were no postoperative problems.

Inclusion Criteria

1. Mature Cataract
2. Immature Cataract with DR but macula is dry

Exclusion Criteria

1. Immature Cataract with Diabetic Maculopathy
2. Patients with other risk factors that promote retinopathy eg. HTN, Hyperlipidemia, Obesity

Data collection and examination

A comprehensive medical and ocular history was obtained from all patients one week before their cataract operation. Patients' ages, the existence of concomitant hypertension, the length of time from their diabetes diagnosis, and their current treatment regimen were documented. All patients' preoperative glycemic control was evaluated using an HbA1C test.

One week before to surgery, all patients received a comprehensive fundus examination, which included a fundus viewing lens inspection, and the state of retinopathy and maculopathy in both eyes was recorded.

In all cases, FFA was done to assess the exact scenario of the retina. In cases where lens opacity blocked the image of the retina, the preoperative retinopathy status was deemed to be the same as that documented on the first postoperative day [18, 19]. In case of matured cataract, retinal condition of the fellow eye was considered as same as the cataractous eye. The diabetic retinopathy of a patient was rated using the ETDRS grading method (table 1).

After surgery, all patients were assessed on postoperative day 1, then 1, 6, and 12 months later. At each examination, both the eye's visual acuity and retinopathy status were documented. As required by clinical need, further follow-up was scheduled. By established recommendations, pan-retinal photocoagulation (PRP) was done on all patients who acquired proliferative diabetic retinopathy. As soon as it was feasible, these patients were treated with focused or grid laser photocoagulation, as outlined by the ETDRS.

This computation was performed for the group of eyes that had not been operated on. The relationship between the advancement of retinopathy and maculopathy in the operated and non-operated eyes and the preoperative parameters mean HbA1c, length of diabetes, the existence of preexisting hypertension, and insulin therapy was then analyzed using logistic regression.

Table 1: ***ETDR Retinopathy grading system***

A	Mild NPDR	Micro aneurysms only
B	Moderate NPDR	H/Ma moderate in 4–5 fields or severe in 1 field or IRMA definite in 1–3 fields
C	Moderately Severe NPDR	Both level 43 characteristics – H/Ma moderate in 4–5 fields or severe in 1 field and IRMA definite in 1–3 fields **or** any one of the following: IRMA in 4–5 fields HMA severe in 2–3 fields VB definite in 1 field
D	Severe NPDR	One or more of the following: ≥ 2 of the 3 levels, 47 Characteristics H/Ma severe in 4–5 fields IRMA ≥ moderate in 1 field VB ≥ definite in 2–3 fields
E	Quiescent PDR	Proliferative DR previously treated with pan-retinal laser photocoagulation
F	Proliferative DR	Any NVD, NVE, pre-retinal, or vitreous hemorrhage, or fibrous tissue proliferation

Statistical analysis

Results

Following up for 12 months was completed by all 36 patients. Twenty-one other eyes were pseudophakic. Throughout the study, six people had surgery on the second eye; one had been done after six months and the other after eight. Table 2 shows the preoperative demographic information. In this research, individuals who had cataract surgery were 60 ± 9.34 years old.

21 (58.3%) of the patients were male and the mean ± SD duration of diabetes was 18 ± 10.18. At their preoperative evaluation, 17 patients (47.2%) were getting oral hypoglycemic, 12 patients (33.3%) were receiving insulin and the remaining 7 (19.4%) were being managed only by diet. The preoperative Snellen visual acuity ranged from 6/12 to "hand movement" with a median of 6/36. Maximum patients of 50% have < 6/60 visual acuity and 27.8% of the patient's preoperative visual acuity was between the ranges of 6/12 to 6/18.

Table 2: ***Preoperative demographic status***

Variables	n	%
Gender		
Male	21	58.3
Female	15	41.7
Age (mean) in years	60 ± 9.34	
Duration of diabetes in years	18 ± 10.18 (5-23)	
Diabetes treatment		
Insulin usage	12	33.3
Tablet controlled	17	47.2
Diet controlled	7	19.4
Preoperative visual acuity		
>6/12	3	8.3
6/12-6/18	10	27.8
6/24-6/36	5	13.9
<6/60	18	50

Table 3: ***Analysis of the development of diabetic retinopathy in relation to each of the preoperative variables***

Preoperative factors	Operated eyes			Non-operated eyes		
	DR stable (n=29)	DR progression (n=7)	*P* value	DR stable (n=25)	DR progression (n=11)	*P* value
Gender						
Male (n=21)	14/29	5/7	0.021	13/25	8/11	0.038
Female (n=15)	11/29	4/7		10/25	5/11	
Preoperative HbA1C mean± SD	7.1 ± (1.6) (%)	9.9 ± 1.3 (%)	0.001	8.7 ± 1.1 (%)	10.1 ± 1.2 (%)	0.000
DM duration (Mean± SD)	11.4±5.7	12.3 ±9.2	0.112	13.5 ±7.5	11.2 ±8.4	0.143
Insulin treatment	6/29	7/7	0.023	6/25	11/11	0.027

Student's paired t-test in both the operated (OE) and non-operated (NoE) showed in Table 4 that patients with progressing retinopathy had higher mean HbA1C values than patients whose retinopathy were stable (OE p=0.001, NoE p=0.000). Males were more prone to DR progression than the females, however, no significant association was found in both OE and NoE groups. In neither group did the duration of diabetes vary significantly between individuals whose retinopathy advanced and those whose retinopathy did not advance. In both the operated and unoperated eyes, there was no significant difference in the proportion of patients with pre-existing hypertension and retinopathy progression. In comparison, patients who required insulin, substantially developed retinopathy progression in both eyes postoperatively than the patients who did not require insulin treatment (OE p=0.023, NoE p=0.027).

Table 3 shows the logistic regression analysis for retinopathy progression in operated and un-operated eyes with cataracts. The advancement of diabetic retinopathy in either eye after cataract surgery was not significantly associated with any preoperative characteristics, according to a logical regression analysis, except for age.

Discussion

In our finding, in the twelve months after cataract extraction, diabetic retinopathy (DR) progressed in 16.7% of eyes who had cataract surgery. After cataract surgery, the proportion of individuals who develop retinopathy progression varies widely, according to a survey of the scientific literature. Mittra et al. describe a similar finding, stating that merely 15% of patients operated on by a senior surgeon progressed to DR [20]. Other authors have observed progression rates of above 70% for retinopathy [21]. According to a study by Jeng CJ et al. [22], cataract surgery considerably increases the likelihood of developing NPDR. Several factors are known to impact the pace of DR development following cataract surgery, including the severity of the preoperative DR [12,23,24], the length of diabetes [25], adequate glycemic management [12,25], and age [12]. Therefore, direct comparisons between different studies are only acceptable if comparable patient groups were obtained.

Our discovery that diabetic retinopathy advanced in eleven non-operated eyes throughout the research is fascinating since it is probable that any advancement of retinopathy detected in these

Table 4: ***Logistic regression analysis for retinopathy progression in operated and un-operated eyes***

Preoperative factors	Operated eyes (n=36)		Non-operated eyes (n-36)	
	Odds ratio (95% CI)	*P value*	Odds ratio (95% CI)	*P value*
Age	3.9 (1.3 to 6.7)	0.00	9.5 (1.6 to 35.8)	0.00
Gender	6.7 (0.7 to 61.3)	0.08	15.8 (0.7 to 68.0)	0.09
Preoperative HbA1C	1.5 (0.5 to 2.0)	0.89	1.7 (0.9 to 2.3)	0.79
DM duration	0.9 (0.4 to 1.5)	0.66	1.6 (0.2 to 2.1)	0.64
Pre-existing hypertension	1.1 (0.4 to 3.4)	0.78	2.9 (0.6 to 12)	0.96
Insulin treatment	4.7 (1.2 to 16.2)	0.85	7.5 (1.4 to 13.2)	0.85

cases represents spontaneous disease progression. Although it is challenging to extrapolate these statistics to the group of operated eyes, they show that the majority of the retinopathy development identified in this cohort was not a direct result of the operation. The UKPDS indicated that glycemic management is closely connected to the severity and development of DR in individuals with type 2 diabetes [26]. The fact that the DR progression observed in our study was symmetrical in the majority of cases, occurred more frequently in patients with poor glycemic control and had poor glycemic control as a significant risk factor for its development, suggests that the majority of the retinopathy progression observed in both cohorts of eyes was due to the disease's natural history. One additional prospective research has also studied the association between glycemic management and DR progression following cataract surgery, and its findings corroborate our findings. Patients who need insulin for glucose regulation are connected with the development of DR. In prospective research by Henricsson et al. [12], patients who switched from oral hypoglycemic medications to insulin had a greater relative risk of advancement. In their investigation, the risk indicators for advancement were greater HbA1c and mild NPDR at baseline. Those who use insulin at baseline are otherwise not at risk. After correcting for DM duration, the link between DR and insulin was attenuated in a meta-analysis [27]. In our finding, no association was found between the DR progression and DM duration.

Klein et al. observed that women had a greater incidence of cataract extraction than males among diabetic patients [25]. However in our study, males had greater incidence of cataract surgery and progression of DR. In our finding age is significantly associated with cataract and DR progression. Ostri et al. [28] observed that the postoperative corrected visual acuity of diabetic patients undergoing cataract surgery was influenced by the degree of DR and age, especially in individuals with a history of focused laser therapy for CSME. In the ETDRS, operated eyes exhibited a greater tendency toward two-step DR development than un-operated eyes; however, this difference was not statistically significant. Furthermore, the percentage of eyes developing CSME was not significantly different regardless of lens extraction [29]. Prospective research indicated that lens surgery had no effect on the development and progression of DR, which instead followed its normal course. Similarly, in our finding, it is reported that those cataract patients who did not undergo surgery also had progression in DR, which may be due to natural medical history.

Conclusion

Any trauma like cataract operation DR as inflammation deteriorates vascular changes in the retina. So strict control of DM as well as proper post-operative management to avoid Ocular inflammation is crucial. It is noted that prolonged operative time and excessive handling of ocular tissue should be avoided during operation.

References

1. Flaxman SR, Bourne RR, Resnikoff S, Ackland P, Braithwaite T, Cicinelli MV, Das A, Jonas JB, Keeffe J, Kempen JH, Leasher J. Global causes of blindness and distance vision impairment 1990–2020: a systematic review and meta-analysis. The Lancet Global Health. 2017 Dec 1;5(12):e1221-34.
2. Liu YC, Wilkins M, Kim T, Malyugin B, Mehta JS. Cataracts. The Lancet. 2017 Aug 5;390(10094):600-12.
3. Klein BE, Klein R, Moss SE. Prevalence of cataracts in a population-based study of persons with diabetes mellitus. Ophthalmology. 1985 Sep 1;92(9):1191-6.
4. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes care. 2004 May 1;27(5):1047-53.
5. Drinkwater JJ, Davis WA, Davis TM. A systematic review of risk factors for cataract in type 2 diabetes. Diabetes/metabolism research and reviews. 2019 Jan;35(1):e3073.
6. Hamilton AM. Management of diabetic retinopathy. Transactions of the Ophthalmological Societies of the United Kingdom. 1977 Sep 1;97(4):494-6.
7. Hamilton AM. Management of diabetic retinopathy. Transactions of the Ophthalmological Societies of the

United Kingdom. 1977 Sep 1;97(4):494-6.

8. Aiello LM, Wand M, Liang G. Neovascular glaucoma and vitreous hemorrhage following cataract surgery in patients with diabetes mellitus. Ophthalmology. 1983 Jul 1;90(7):814-20.
9. Jaffe GJ, Burton TC, Kuhn E, Prescott A, Hartz A. Progression of nonproliferative diabetic retinopathy and visual outcome after extracapsular cataract extraction and intraocular lens implantation. American journal of ophthalmology. 1992 Oct 1;114(4):448-56.
10. Moriarty AP, Spalton DJ, Moriarty BJ, Shilling JS, Ffytche TJ, Bulsara M. Studies of the blood-aqueous barrier in diabetes mellitus. American journal of ophthalmology. 1994 Jun 1;117(6):768-71.
11. Liu Y, Luo L, He M, Liu X. Disorders of the blood-aqueous barrier after phacoemulsification in diabetic patients. Eye. 2004 Sep;18(9):900-4.
12. Henricsson M, Heijl A, Janzon L. Diabetic retinopathy before and after cataract surgery. British journal of ophthalmology. 1996 Sep 1;80(9):789-93.
13. Hong T, Mitchell P, de Loryn T, Rochtchina E, Cugati S, Wang JJ. Development and progression of diabetic retinopathy 12 months after phacoemulsification cataract surgery. Ophthalmology. 2009 Aug 1;116(8):1510-4.
14. Jaffe GJ, Burton TC, Kuhn E, Prescott A, Hartz A. Progression of nonproliferative diabetic retinopathy and visual outcome after extracapsular cataract extraction and intraocular lens implantation. American journal of ophthalmology. 1992 Oct 1;114(4):448-56.
15. International Diabetes Federation Diabetes Atlas eight edition. 2017. URL : https://www.diabetesatlas.org [accessed 2022-10-17]
16. Kc B. Socioeconomic variables responsible for diabetic retinopathy among Bangladeshi adults. Biomedical Journal of Scientific & Technical Research. 2020;25(1):18829-36.
17. Hossain MF, Nandi DC, Ahsan N. Knowledge, attitude and practices regarding common eye disease in Bangladesh: a study of Cumilla zone. Knowledge, Attitude and Practices Regarding Common Eye Disease in Bangladesh: A Study of Cumilla Zone. 2020;25(4):2279-0845.
18. Scanlon PH. The English national screening programme for diabetic retinopathy 2003–2016. Acta diabetologica. 2017 Jun;54(6):515-25.
19. Early Treatment Diabetic Retinopathy Study Research Group. Fundus photographic risk factors for progression of diabetic retinopathy: ETDRS report number 12. Ophthalmology. 1991 May 1;98(5):823-33.
20. Mittra RA, Borrillo JL, Dev S, Mieler WF, Koenig SB. Retinopathy progression and visual outcomes after phacoemulsification in patients with diabetes mellitus. Archives of Ophthalmology. 2000 Jul 1;118(7):912-7.
21. Jaffe GJ, Burton TC, Kuhn E, Prescott A, Hartz A. Progression of nonproliferative diabetic retinopathy and visual outcome after extracapsular cataract extraction and intraocular lens implantation. American journal of ophthalmology. 1992 Oct 1;114(4):448-56.
22. Jeng CJ, Hsieh YT, Yang CM, Yang CH, Lin CL, Wang IJ. Development of diabetic retinopathy after cataract surgery. PloS one. 2018 Aug 22;13(8):e0202347.
23. Pollack A, Leiba H, Bukelman A, Abrahami S, Oliver M. The course of diabetic retinopathy following cataract surgery in eyes previously treated by laser photocoagulation. British journal of ophthalmology. 1992 Apr 1;76(4):228-31.
24. Zaczek A, Zetterström C. Posterior capsule opacificationafter phacoemulsification in patients with diabetes mellitus. Journal of Cataract & Refractive Surgery. 1999 Feb 1;25(2):233-7.
25. Klein BE, Klein R, Moss SE. Prevalence of cataracts in a population-based study of persons with diabetes mellitus. Ophthalmology. 1985 Sep 1;92(9):1191-6.
26. Kohner EM, Aldington SJ, Stratton IM, Manley SE, Holman RR, Matthews DR, Turner RC. United Kingdom Prospective Diabetes Study, 30: diabetic retinopathy at diagnosis of non–insulin-dependent diabetes mellitus and associated risk factors. Archives of Ophthalmology. 1998 Mar 1;116(3):297-303.
27. Zhao C, Wang W, Xu D, Li H, Li M, Wang F. Insulin and risk of diabetic retinopathy in patients with type 2 diabetes mellitus: data from a meta-analysis of seven cohort studies. Diagnostic pathology. 2014 Dec;9(1):1-7.
28. Ostri C, Lund-Andersen H, Sander B, La Cour M. Phacoemulsification cataract surgery in a large cohort of diabetes patients: visual acuity outcomes and prognostic factors. Journal of Cataract & Refractive Surgery. 2011 Nov 1;37(11):2006-12.
29. Chew EY, Benson WE, Remaley NA, Lindley AA, Burton TC, Csaky K, Williams GA, Ferris FL, Early Treatment Diabetic Retinopathy Study Research Group. Results after lens extraction in patients with diabetic retinopathy: early treatment diabetic retinopathy study report number 25. Archives of ophthalmology. 1999 Dec 1;117(12):1600-6.